



Advances in Head  
& Neck Free Flap  
Reconstruction (page 4)

Editor-in-Chief  
**Paul R. Lambert, M.D.**  
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Associate Editor  
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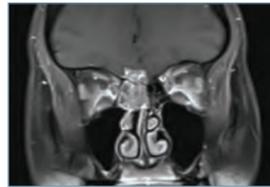
Administrative Coordinator  
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# the SCOPE

MUSC Department of Otolaryngology Head & Neck Surgery



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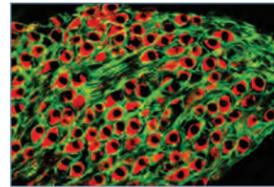
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Cover illustration by  
Emma Vought



## Chairman's Corner

### TRANSITION

The term “generation” is a convenient way to denote a cohort of people who have experienced similar formative experiences: the Baby Boomers (to which I belong), Gen X, Millennials, etc. The term can also be used to define periods of time within the life cycle. For example, a) age 0–25: physical and personal development → adulthood; b) age 25–50: family, college/professional development → career; c) age 50–75: career → retirement; d) age 75–100: I take the liberty of nominating this last interval as the “wisdom of age generation.”

Having immensely enjoyed each of these periods (OK, period “a” was a little rocky and uncertain at times), I am now well into period “c.” In fact, 2021 marks my transition from chair to faculty member.

The last 22 years as chair of the Otolaryngology–Head and Neck Surgery Department at MUSC has widely surpassed what I envisioned when I left Charlottesville in 1999. I will forever consider my 17 years at UVA to be the foundational period of my professional development. The lessons learned from established leaders within the department during that time were invaluable. The opportunity to put those lessons into practice, to recruit incredible men and women to MUSC, and to engage them in ongoing strategy to build our tripartite mission were all duties of delight.

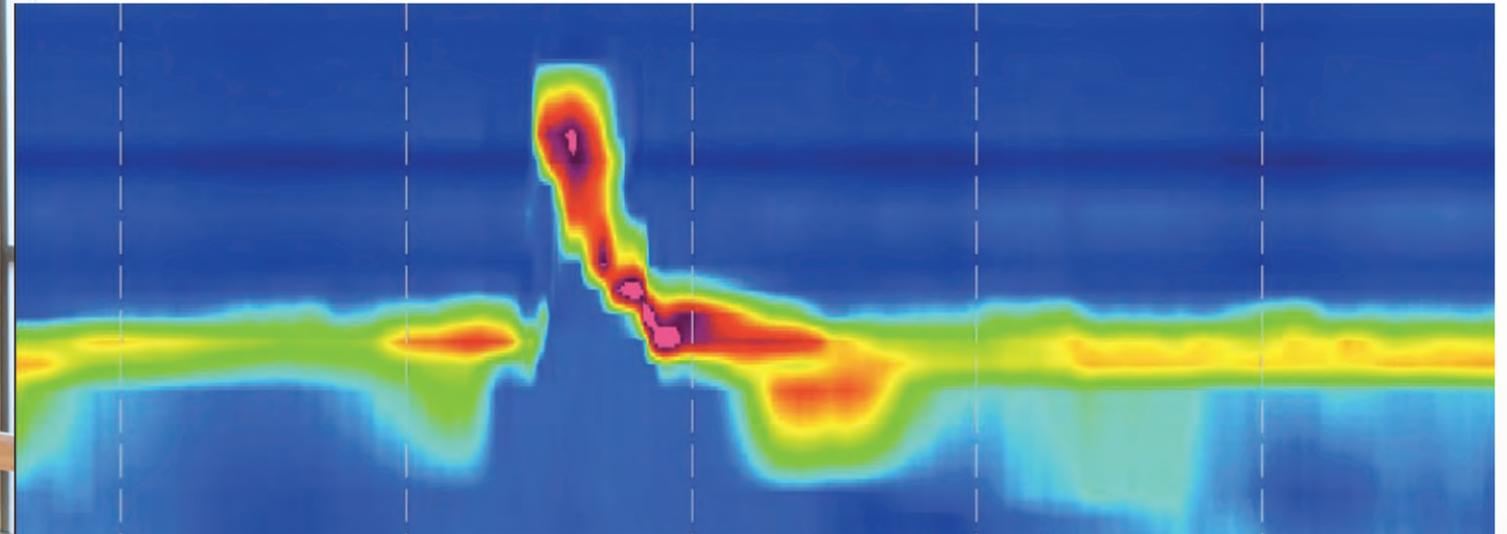
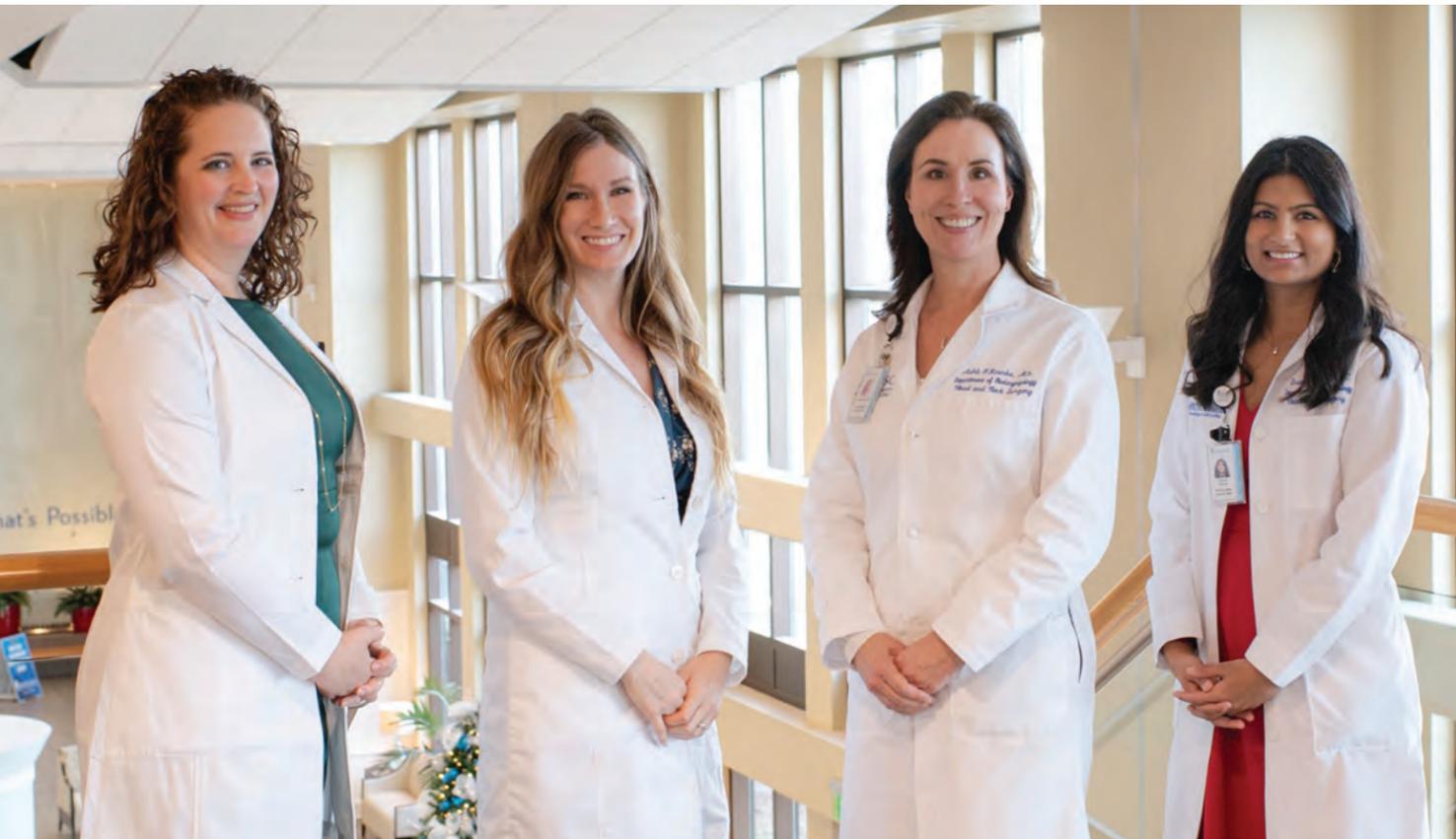
It has been an amazing journey, one that energized my life and brought much professional and personal satisfaction. I am humbled and blessed to have been the steward of our Department these many years, but like all stewardships such a position is just temporary (any parent knows this fact). I recently told the Department that what we have achieved in the last two decades has been a collective effort – pure and simple. No one person or division can take credit. My respect for each member of the Department is unequivocal, my appreciation inexpressible, and thus the decision to retire as chair, in the strongest possible way, expresses the confidence I have in them to continue building on our foundation of excellence. They indeed are the heart and soul of the Department.

*Paul R. Lambert, M.D.*

Paul R. Lambert, M.D.  
Professor and Chair  
Department of Otolaryngology - Head & Neck Surgery

## Laryngology Update

Ashli K. O'Rourke, M.D.



Melissa Cooke, MS, CCC-SLP, Kate Davidson, MS, CCC-SLP, Ashli K. O'Rourke, M.D., Drasti Smyre, MS-PAS

There have been some recent exciting changes in the Laryngology Division. In January 2021, we will open our new Evelyn Trammell Institute for Voice and Swallowing Center at the MUSC Health East Cooper Medical Pavilion in Mount Pleasant (7 miles from our downtown Charleston campus). This new space will more than double our clinical footprint and updates our technical equipment to remain on the forefront of state of the art care. Dedicated procedure rooms will allow improved access to timely in office procedures and an increase in expertly trained, dedicated staff ensures unparalleled patient care.

Also, this year, Ashli K. O'Rourke, M.D., Director of Laryngology, was awarded the **Mark and Evelyn Trammell Endowed Chair in Otolaryngology**. The endowment was made possible by the generosity of the Mark and Evelyn Trammell Foundation of Atlanta. Former faculty member, **Bonnie Martin-Harris, Ph.D.** established the relationship with the Foundation and created the first MUSC Evelyn Trammell Institute for Voice and Swallowing (ETIVS) nearly 20 years ago. **Lucinda A. Halstead, M.D.** serves as the Medical Director of this Center, which was the first in South Carolina to provide a multidisciplinary center for the evaluation, treatment and clinical research of laryngeal, voice, and swallowing disorders. Dr. Halstead will continue to head the successful downtown Center.

In February 2020, we welcomed **Drasti Smyre, MS-PAS**, to our Laryngology team. Ms. Smyre earned her undergraduate degree in Biological Sciences from the University of South Carolina in 2015 and completed her Physician Assistant

degree at MUSC. Her clinical interests include voice and swallowing disorders, Modified Barium Swallow Studies, high resolution esophageal manometry and pH-Impedance testing.

On the educational front, we have been approved to establish the Department's first ever Fellowship in Laryngology in 2022 and are interviewing for this position now. Our Fellowship will cover the entire spectrum of voice, swallowing and airway disorders. Some of the unique experiences we offer are:

- Professional voice care and neurology
- Advanced endoscopic and open surgical management of airway disorders

- Advanced endoscopic and open surgical management of swallowing disorders
- Office based procedures, including: laser use, injection augmentation, serial intralesional steroid injections for airway stenosis, electromyography, botulinum toxin injections and transnasal esophagoscopy
- Intensive experience with high resolution pharyngeal and esophageal manometry, pH-impedance monitoring, and videofluoroscopic swallowing evaluation (all on site).

Speech Pathology continues to remain closely aligned with the Center. Over the past year, we were fortunate to be able to welcome back two fantastic speech language pathologists: **Melissa Cooke, MS, CCC-SLP** and **Kate Davidson, MS, CCC-SLP**. Additionally, the Center will be collaborating with the newly developed MUSC Masters in Speech-Language Pathology (SLP) program, directed by **Heather Bonilha, Ph.D., CCC-SLP**. This partnership strengthens our research, education and clinical ties with speech pathology. It also enhances the educational and training experience for both SLPs and physician trainees, and also directly improves patient care.

These are exciting times for the MUSC Laryngology Division and the Evelyn Trammell Institute for Voice and Swallowing. Our core mission is to provide the best care possible for our patients and community. □

# Advances in Free Flap Reconstruction for Common Head and Neck Scenarios

Evan M. Graboyes, M.D., MPH, FACS

Head and neck cancer (HNC) arises in cosmetically and functionally critical areas. Treatment, which includes combinations of surgery, radiation, and chemotherapy, can result in devastating life-altering morbidity related to disfigurement, difficulty swallowing, impaired smiling, and challenges speaking.<sup>1</sup> Optimal rehabilitation for these patients involves a multi-disciplinary approach and often includes complex reconstructive surgery. When considering surgery for head and neck oncologic patients, one must always keep in mind the ultimate goals of survival, functional outcomes and cosmesis. A surgeon's responsibility is to weigh the patient's goals, perioperative risk, and potential complications with the operative plan that provides the optimal reconstructive option for each individual scenario.

Although free flap reconstruction is the standard of care for complex defects resulting from the surgical ablation of HNC or post-radiation treatment complications, free flaps may be underutilized in certain clinical scenarios. However, advances in preoperative surgical planning,<sup>2</sup> refinements of surgical technique,<sup>3</sup> and the development of optimized enhanced recovery<sup>4</sup> and perioperative care pathways<sup>5</sup> have resulted in

shorter recovery times, less morbidity, improved functional outcomes, and better cosmesis. In addition, emerging data continue to reinforce the safety and effectiveness of free flaps in the increasingly prevalent geriatric population.<sup>6</sup> As a result, the clinical indications for free flap reconstruction of head and neck defects and the eligible patient population continue to expand, with evolving indications presenting new opportunities to improve patient outcomes (Table 1). This article describes common clinical situations in which free flap reconstruction may be underutilized, but indicated to improve patient outcomes as a result of continued advancements in reconstructive surgery.

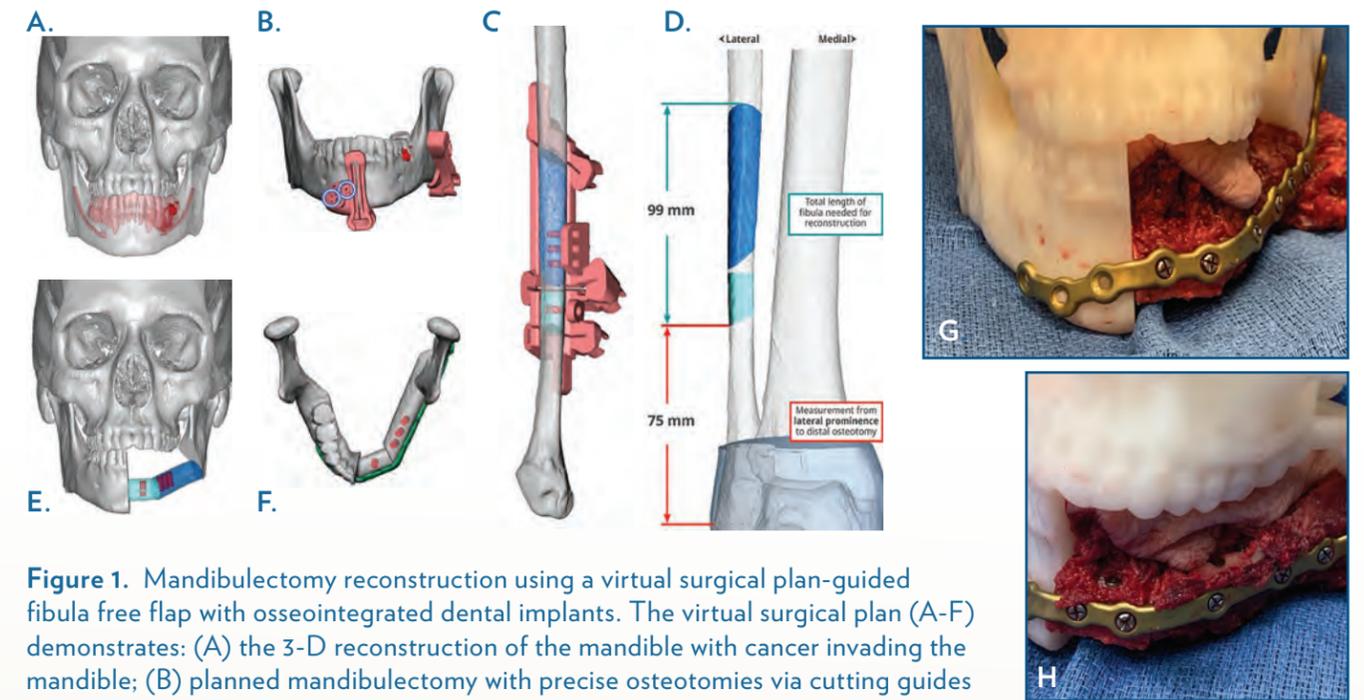
## Mandibulectomy

Standard of care for locally advanced cancer invading the mandible involves surgical extirpation via segmental mandibulectomy. In addition, clinically significant osteoradionecrosis (ORN) of the mandible occurs in 5 to 15 percent of patients treated with standard of care intensity-modulated radiation therapy.<sup>7</sup> With the exponential increase in the number of HNC survivors treated with radiation therapy, the number of patients experiencing clinically significant ORN refractory to conservative measures and requiring mandibulectomy and free flap reconstruction continues to grow.<sup>8</sup> For patients with defects of the mandible, recent advancements in computer-aided design/computer-aided manufacturing (CAD/CAM), particularly when combined with osseointegrated implant-based dental rehabilitation, has resulted in significant improvement in the aesthetic and functional outcomes for these patients.<sup>2,9</sup>

Virtual surgical planning (VSP) has emerged as a state-of-the-art technique that provides an opportunity to virtually plan and attempt to replicate a pre-operative state of anatomic precision in mandibular reconstruction and maxillomandibular relationship while preparing for dental rehabilitation all during the same ablative surgical procedure. During the VSP stage of CAD/CAM, the ablative surgeon, reconstructive microsurgeon, oral surgeon, maxillofacial prosthodontist, and biomedical engineer work together. Using computer models based on data from high-resolution computed tomography (CT) scans of the surgical resection

**Table 1: Expanding Indications for HN Free Flaps**

Clinical Indication for Free Flap Reconstruction	Relevant Reconstructive Advancement(s) Resulting in Expanding Free Flap Indications and Improved Patient Outcomes
Mandibulectomy/Maxillectomy (for cancer, osteoradionecrosis, or trauma)	<ul style="list-style-type: none"> <li>Osseointegrated implant-based dental rehabilitation<sup>9</sup></li> <li>Virtual surgical planning<sup>2</sup></li> </ul>
Salvage total laryngectomy (for cancer or laryngeal dysfunction)	<ul style="list-style-type: none"> <li>Data supporting benefit of free flaps at decreasing morbidity and improving functional outcomes<sup>13</sup></li> <li>Chimeric ALT designs<sup>14,15</sup></li> <li>Improved surgical techniques<sup>16</sup></li> </ul>
Total parotidectomy (with/without facial nerve sacrifice)	<ul style="list-style-type: none"> <li>Adipofascial ALT for contouring<sup>17</sup></li> <li>Chimeric ALT designs (with innervated vastus lateralis for facial reanimation)<sup>14,18</sup></li> </ul>



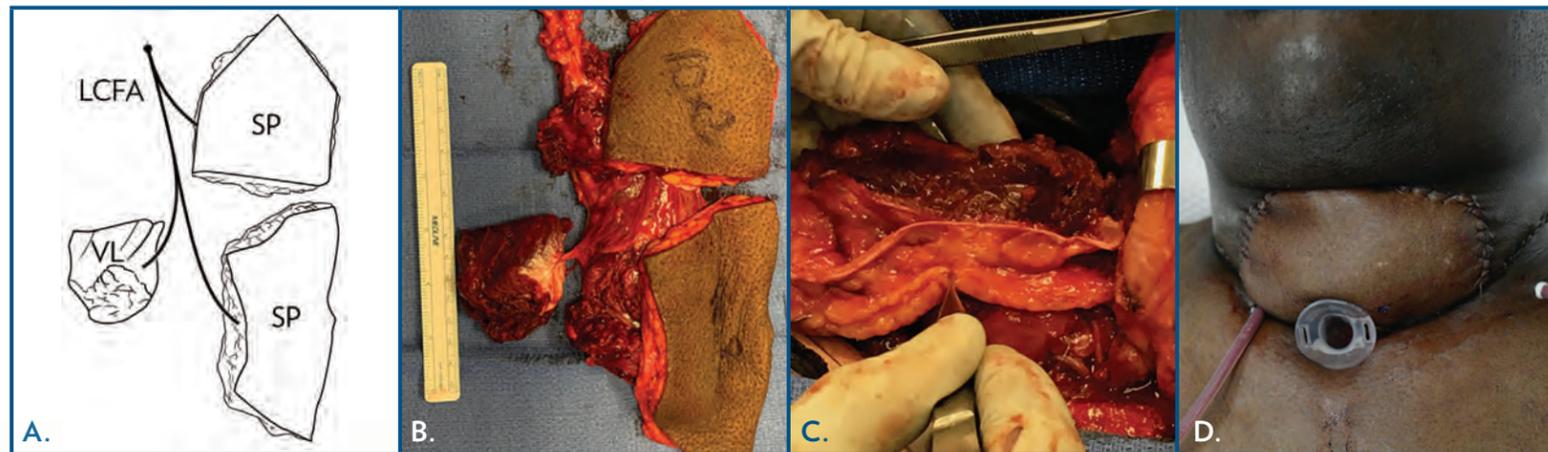
**Figure 1.** Mandibulectomy reconstruction using a virtual surgical plan-guided fibula free flap with osseointegrated dental implants. The virtual surgical plan (A-F) demonstrates: (A) the 3-D reconstruction of the mandible with cancer invading the mandible; (B) planned mandibulectomy with precise osteotomies via cutting guides that are affixed intraoperatively to the mandible; (C) planned right fibula free flap with guides for the osteotomies affixed intraoperatively; note planning and guidance of osseointegrated dental implants x4 (red cylinders); (D) two fragments of the fibula following osteotomies/osteotomies; (E) precisely shaped fibula inset into the mandibulectomy defect; (F) patient-specific mandible reconstruction plate contoured to the native mandible and fibula free flap; (G, H) intraoperative photograph demonstrating the precise fit of the fibula into the stereolithic model of the mandible, the patient-specific reconstruction plate, and relationship of the dental implants to the maxillary occlusal surface.

site and free flap donor sites, the team (1) carefully maps the planned ablative surgery, (2) plans the reconstructive surgery and precisely shape the free flap to restore the shape of the mandible, (3) determines optimal placement of dental implants into the free flap for dental prosthetic rehabilitation, and (4) shapes a patient-specific mandible reconstruction plate to conform precisely to the reconstructed mandible (Figure 1). A computer-aided manufacturing process follows the VSP to generate patient-specific products to guide surgery intraoperatively including (1) cutting guides for the osteotomies in the mandible and free flap, (2) guides for the dental implants, (3) a stereolithic model of the reconstructed mandible, and (4) the customized mandible reconstruction plate. VSP-based mandible reconstruction has a number of benefits relative to non-VSP-based mandible reconstruction including improved orthognathic measurements, reduced ischemia time, shorter overall operative time, decreased overall cost, and improved patient outcomes.<sup>2</sup>

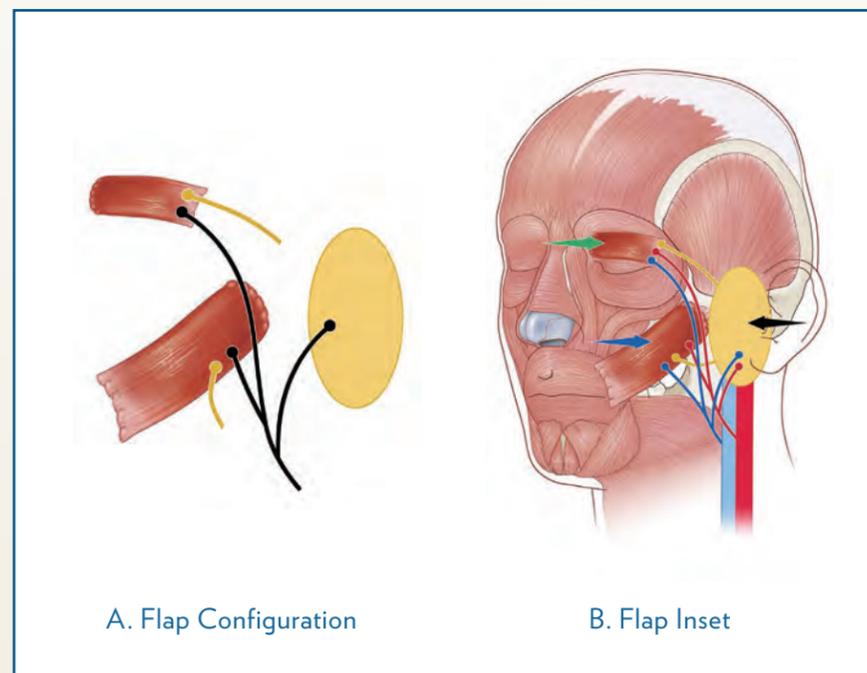
## Salvage Total Laryngectomy

Concurrent chemoradiation (CRT) has become the preferred treatment paradigm for eligible patients with locally advanced cancer of the larynx or hypopharynx. Unfortunately, 1/3 of patients eventually require a salvage total laryngectomy (TL) for persistent/recurrent disease or laryngeal dysfunction.<sup>10</sup> Due to impaired wound healing following CRT, up to 1/3 of patients undergoing salvage TL develop a pharyngocutaneous fistula (PCF)<sup>11</sup>, a morbid complication that delays or permanently inhibits oral intake, prolongs hospitalization, and increases mortality.<sup>11</sup> For patients undergoing salvage TL, incorporating vascularized tissue into the reconstruction through a regional or microvascular free flap decreases the risk of developing a PCF, duration of PCF, and need for additional surgery.<sup>11,12</sup> Emerging data suggest that reconstruction with a free flap, particularly those without muscle, results in better long

## Head &amp; Neck Reconstruction continued....



**Figure 2.** Salvage total laryngectomy reconstruction using a chimeric anterolateral thigh free flap. (A) Schematic representation of a chimeric anterolateral free flap showing two independent perforator-based skin paddles (SPs) and an independent vastus lateralis (VL) muscle flap linked by a common source vessel (lateral circumflex femoral artery; LCFA); (B) intraoperative photograph demonstrating chimeric anterolateral thigh flap harvest with one skin paddle to reconstruct the pharyngeal mucosal defect, the second skin paddle to reconstruct the cutaneous peristomal defect, and the muscle to obliterate dead space; (C) circumferential cuff of fascia surrounding the anterolateral thigh that can be inset as a second layer of closure; (D) photograph at the conclusion of the reconstruction showing the reconstruction of the peristomal cutaneous defect.



**Figure 3.** (A) Schematic demonstrating chimeric anterolateral thigh free flap with vascularized skin paddle and two separate vascularized, innervated slips of vastus lateralis muscle; (B) schematic demonstrating inset of the skin paddle (black arrow) into the parotidectomy defect, the small muscle flap (green arrow) into the upper eyelid to assist with eye closure, and the larger muscle flap (blue arrow) into the oral commissure to suspend the mid-face. Two neurotomy procedures are performed to minimize synkinesis; the motor nerve to vastus lateralis from the larger muscle flap is coapted to the nerve to the masseter. The motor nerve to the smaller vastus lateralis muscle slip undergoes end-to-end neural coaptation to the upper division of the facial or main facial nerve stump.<sup>18</sup>

term speaking and swallowing outcomes.<sup>13</sup> The anterolateral thigh (ALT) free flap is a particularly appealing reconstructive option for salvage TL defects because it can be harvested as a chimeric flap<sup>14,15</sup> (i.e. two or more independent skin or muscle flaps without physical interconnection except where linked by a common source vessel) (Figure 2A). The independent skin paddle design of the chimeric ALT flap is ideal for complex three-dimensional reconstructions encountered during salvage TL: one skin paddle can reconstruct the pharyngeal mucosal defect and the second can reconstruct the cutaneous peristomal defect (Figure 2B/D). The ALT also allows for the harvest of a circumferential cuff of fascia that can be inset as a second layer of closure (Figure 2C), a technique associated with a further decrement in risk of PCF.<sup>16</sup>

### Total Parotidectomy with/without Facial Nerve Sacrifice

Defects of the parotid gland, whether from regionally metastatic cutaneous malignancies or primary neoplasms of the parotid gland, can result in a significant disfiguring contour defect, and in many cases, an exposed or resected facial nerve, temporal bone, or mandible, with subsequent negative impact on quality of life. The ALT free flap is an optimal choice for reconstruction of contour defects in isolated parotidectomy defects. The adipofascial ALT (fat and fascia without overlying skin) provides reliable soft tissue bulk with acceptable donor site morbidity.<sup>17</sup>

In cases of more advanced tumors in which the facial nerve (or branches) are also resected, further debilitating morbidity related to facial asymmetry, exposure keratopathy, and oral incompetence can ensue. For radical parotidectomy defects,

Continued on next page...



**Evan M. Graboyes, M.D., MPH** head and neck oncologic surgeon-scientist, is an assistant professor in the MUSC Department of Otolaryngology - Head & Neck Surgery, and a member of the Cancer Control Program at the Hollings Cancer Center.

As a fellowship-trained head and neck microvascular reconstructive surgeon, Dr. Graboyes' clinical practice focuses on the removal and reconstruction of benign and malignant tumors of the head and neck. Specific areas of expertise include regional and microvascular free flap reconstruction for tumors of the oral cavity, pharynx, and larynx; advanced melanoma and non-melanoma skin cancers; and lesions of the salivary glands.

He uses his advanced scientific training as a healthcare delivery researcher to investigate innovative health care delivery and behavioral interventions to improve the timeliness and equity of care for patients with head and neck cancer as well as minimize late and long term psychosocial toxicity for head and neck cancer survivors. His research, funded through grants from the National Cancer Institute, American Cancer Society, and Doris Duke Charitable Foundation, relies on a collaborative, multi-disciplinary team approach. He has authored

over 75 peer-reviewed publications related to head and neck cancer care delivery and head and neck cancer survivorship.

Dr. Graboyes has leadership roles in regional and national organizations. He is the director of the South Carolina Cancer Alliance Head and Neck Cancer Workgroup, a member of Head and Neck Oncology & Surgery and Patient Safety/Quality Improvement Committees of the American Academy of Otolaryngology - Head and Neck Surgery, and a member of the Survivorship, Reconstruction, and Quality and Value Committees of the American Head and Neck Society. He serves on the editorial board for JAMA-Otolaryngology-Head & Neck Surgery and the Annals of Otolaryngology, Rhinology, and Laryngology.

Dr. Graboyes was born in St. Louis, Missouri and raised in Wisconsin. He graduated summa cum laude from Princeton University with degrees in philosophy and public policy. He then moved to St. Louis where he completed his medical degree and residency from Washington University School of Medicine. He completed his fellowship in head and neck oncologic and reconstructive surgery from MUSC in 2017. He received his MPH in Health Behavior and Health Promotion from MUSC in 2020.

## Head & Neck Reconstruction continued....

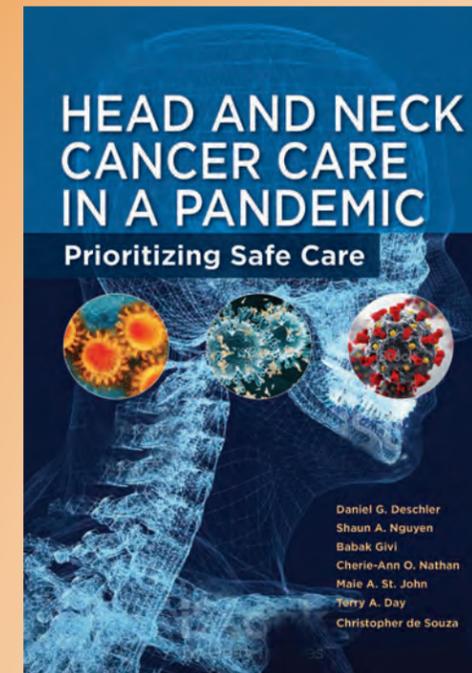
reconstruction with an ALT free flap is an ideal solution to address simultaneously the contour deformity and facial paralysis.<sup>14,17</sup> The ALT flap can be harvested with fascia lata and motor nerve grafts for concurrent orthodromic temporalis tendon transfer and facial nerve cable grafting (from either the proximal facial nerve or masseteric nerve to the distal facial nerve branches). This technique results in satisfactory facial symmetry, facial reanimation, and oral competence.<sup>17</sup> Alternatively, the ALT can be harvested as a chimeric flap with a skin paddle for the facial contour deformity (or cutaneous defect) and two separate segments of innervated vastus lateralis muscle for concurrent midface tone and dynamic reanimation of both the eye and midface (Figure 3).<sup>18</sup> This innovative technique provides excellent cosmetic and functional results.<sup>18</sup>

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## Conclusions

Continued advances in pre-surgical planning, free flap surgical technique, and perioperative care have resulted in shorter recovery times, less morbidity, improved functional outcomes, and better cosmesis. Although the decision to perform free flap reconstruction is complex and reflects numerous patient, provider, and institutional factors, it is clear that the role of free flap reconstruction as a critical tool in the armamentarium of multidisciplinary HNC care continues to expand. These advances in free flap surgery, combined with continued basic science, translational, and clinical research, can help minimize head and neck morbidity, enhance quality of life, and improve survival. □



## EDITORS:

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**Christopher de Souza, M.D., DORL, DNB, FACS**

Available on amazon.com

## Head and Neck Cancer Care in a Pandemic: Prioritizing Safe Care

An up-to-the-moment, comprehensive reference for addressing the complex problems inherent in delivering optimal cancer treatment during a pandemic. Written during the crisis, a major motivation for its publication is the simple fact that delaying treatments for cancers is frequently not an option.

This outstanding volume is unique for its inclusive authorship: contributors represent the heads of renowned departments in leading institutions, residents, fellows, and medical students on the front lines of the pandemic. While providing vital and time-sensitive cancer patient care, the authors have documented lessons learned battling serious diseases and co-morbidities during the COVID-19 emergency.

In addition to an emphasis on the surgical issues of specific diseases, **Head and Neck Cancer Care in a Pandemic** looks at multidisciplinary patient management, education, social issues impact, and general considerations such as telemedicine and protective equipment.

The editors have arranged the text in six sections:

- General Considerations
- Patient Management Considerations
- Subsite-Specific Considerations (Mucosal)
- Subsite-Specific Considerations (Nonmucosal)
- Education in the COVID-19 Era
- Social Issues in the COVID-19 Era

Clinicians, investigators, and students will discover this rare achievement in medical textbooks is a valuable resource in the practice of oncologic care in the COVID-19 era.

## Honors and Awards

### Judy R. Dubno, Ph.D.

- 2020 Alfred K. Kawana Award for Lifetime Achievement in Publications, American Speech-Language-Hearing Association.

### Evan M. Graboyes, M.D., MPH, FACS

- 2020 American Association for Cancer Research Scholar-in-Training Award
- 2020 National Cancer Institute Multilevel Intervention Training Institute Scholar

### Lucinda A. Halstead, M.D.

- President, Performing Arts Medicine Association

### Kelly C. Harris, Ph.D.

- Invited seminar, Age-related changes in afferent input: Associations with cortical plasticity and speech recognition. Northeast Ohio Medical University, Department of Anatomy and Neurobiology Seminar Series. Rootstown, Ohio.

### Carolyn McClaskey, Ph.D.

- Second Place, Oral Presentation in Postdoc/Resident/Fellow Category, 55th Annual Perry V. Halushka MUSC Research Day

### Shaun A. Nguyen, M.D., FAPCR

- Appointed to serve as an expert on a panel for National Courts and Sciences Institute (NCSI), the American Home for Judicial Training in Science & Technology.
- Editorial Board for the World Journal of Otorhinolaryngology.

### Habib G. Rizk, M.D., MSc

- 2020 Cures Within Reach Foundation Meniere's Disease Grant

# The MUSC Skull Base Center

Teddy R. McRackan, M.D., MSCR

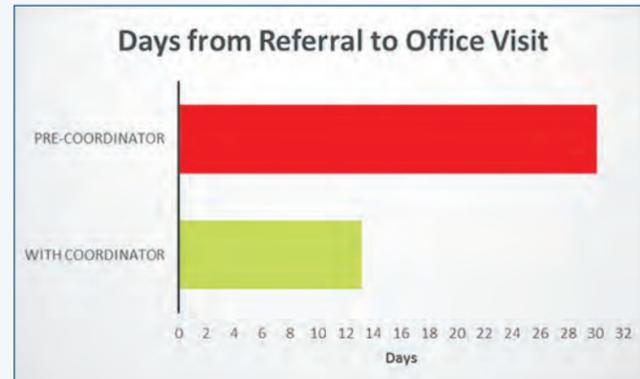
The Skull Base Center at the Medical University of South Carolina was officially established in January 2017, but the foundation has been present and functioning for many years. The formation of the Skull Base Center allows our university to take precision medicine to the next level by providing seamless coordination of care and optimal multidisciplinary treatment of disease of the skull base. In addition, the more recent addition of a full time Skull Base Patient Care Coordinator and routine use of telemedicine has dramatically improved the patient care experience.

## Skull Base Team

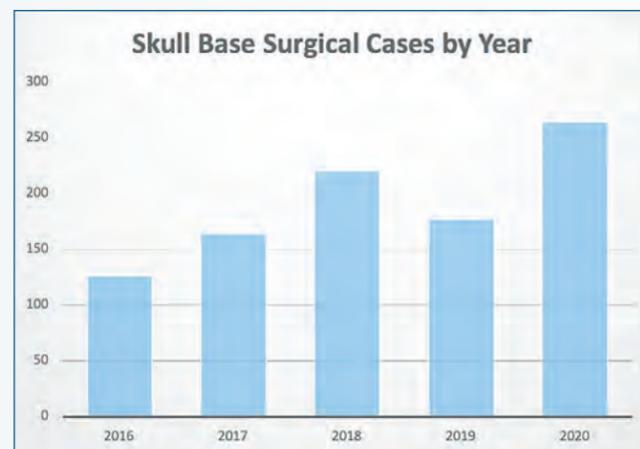
Our team of over 30 physicians is dedicated to providing patient-centered care in line with the treatment goals of each individual patient. Anchored by head and neck surgeons, neurotologists, neurosurgeons, and rhinologists, all physicians on our primary team have been fellowship trained at elite institutions to specialize in skull base care. The team is supplemented by our facial plastics and reconstructive surgeons, neuroendovascular surgeons, radiation oncologists, neuroradiologists, and neuro critical care intensivists. We work together on a daily basis to provide the best and most advanced care possible for our patients.

## Skull Base Coordinator

The success of our Center originates from our Skull Base Patient Care Coordinator, Carly Clarke. She is focused on ensuring that every patient has a smooth and efficient experience in our system. Before every patient's first visit, it is the Coordinator's job to ensure all previous diagnostic testing has been received and reviewed by the team. She then orders and schedules any additional testing needed prior to his or her appointment. All physician appointments and testing are then coordinated to ensure that multiple visits to MUSC are not required. This includes a visit to our pre-operative anesthesia clinic when needed. Patients diagnosed with skull base lesions are often distraught, stressed, and concerned about their diagnosis. Through the concierge service provided by our Skull Base Patient Care Coordinator, we try to make visits to MUSC as seamless and relaxed as possible. As seen in **Figure 1**, this has greatly reduced the wait time for patients to see our Skull Base physicians.



**Figure 1.** The implementation of a full-time Skull Base Patient Care Coordinator has substantially decreased patient appointment wait time.



**Figure 2.** Number of Skull Base surgical cases performed by fiscal year

## Telehealth

While we had full telehealth capability prior to COVID-19, the recent pandemic has dramatically accelerated the implementation of telehealth for our patients. Such visits are now routinely performed and will remain a substantial part of the way we provide care to patients with Skull Base pathology. This is especially important since patients travel from a five-state region (and beyond) for skull base care at MUSC. We currently use telehealth for initial consultation for those who want to minimize travel to Charleston or those who would like a second opinion. In addition, we routinely use telehealth to review follow up imaging and other locally performed diagnostic testing (e.g., audiograms) with patients. This has greatly decreased geographic barriers that prevent access to specialized care for many in our region.

## Growth

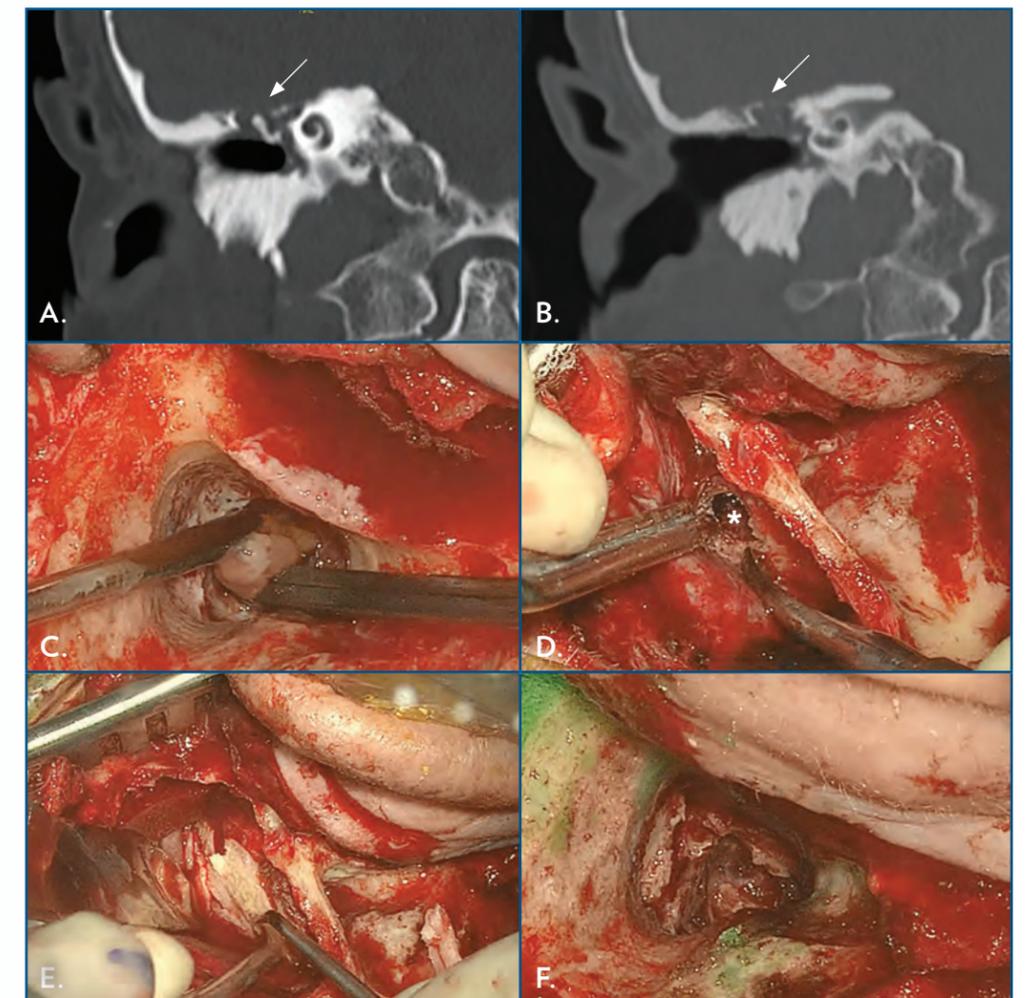
Overall, Skull Base pathology is relatively rare. Given that treatment algorithms for these lesions have dramatically changed over time, it is important that such pathology is treated by a team with extensive experience. Our center has demonstrated substantial growth in the number of patients with these lesions seen over the past five years. In addition, **Figure 2** shows that our surgical volume has increased by 109 percent over this same period, which continues despite the ongoing COVID-19 pandemic.

## Examples of Cases We Treat

### Lateral Temporal Encephalocele and CSF Leak

Patient is a 70-year-old female with five-year history of right sided chronic ear drainage. Her symptoms of otorrhea and aural fullness were constant throughout the day, but she endorsed persistent clear to blood-tinged drainage on her pillow case each morning. She had previously been treated with multiple oral and topical antibiotics with no improvement. Over time she developed a pin point perforation in her right tympanic membrane. On exam, the small perforation was confirmed and found to be associated with clear otorrhea. Given the concern for a CSF leak, a CT scan was ordered, which demonstrated a large defect in the tegmen tympani extending to the tegmen mastoideum (**Figure 3A-B**). The findings were discussed with the patient and we agreed to proceed with operative repair. Based on the CT, we counseled the patient that we would identify the precise location and full extent of the defect

through a mastoidectomy and determine whether a middle fossa craniotomy would be needed for repair. At the time of surgery, the CT findings were confirmed and the tegmen defect extended over the heads of the ossicles. The antrum and attic were completely impacted with the encephalocele (**Figure 3C**). This was removed and the encephalocele was gently separated from the ossicles. Given the extent and location of the defect, we decided that a middle fossa craniotomy would provide greater access for repair. A 2.5x2.5cm craniotomy was then performed and the temporal lobe dura was elevated from a posterior to anterior direction to identify the defect (**Figure 3D**). After the defect was widely isolated a retractor was placed to facilitate repair. The defect was repaired with bone grafts and fascia followed



**Figure 3.** Identification and operative repair of a lateral encephalocele and CSF leak. A-B: Coronal CT images identifying the tegmen defect (arrow). C: Large encephalocele filling the mastoid cavity. D: View of the tegmen defect (asterix) from the middle fossa approach. E: Bone graft overlying the tegmen defect. F: View from the mastoid of the repaired defect.

Continued on next page

### MUSC Skull Base Center continued....

by a dural sealant (Figure 3E). The bone flap was replaced and we confirmed there was no persistent CSF leak by thoroughly investigating the mastoidectomy site (Figure 3F). Patient was admitted to our Neurosciences floor for 24-hour observation and discharged the following day. She has now been followed for 18 months without any recurrence of symptoms.

### Endoscopic Resection of Sinonasal Tumor

A 45-year-old woman presented to her local ENT with several months of right greater than left sided nasal congestion, intermittent epistaxis and “sinus infections” that were not responsive to oral antibiotics and nasal steroid sprays. Nasal endoscopy demonstrated a right sided soft tissue mass that was friable and biopsy was consistent with olfactory neuroblastoma (also known as

esthesioneuroblastoma). Given intracranial extension, it was staged as Kadish C (Figure 4A-B). After exploring local options, she elected to travel across state lines to be treated by our Skull Base Center.

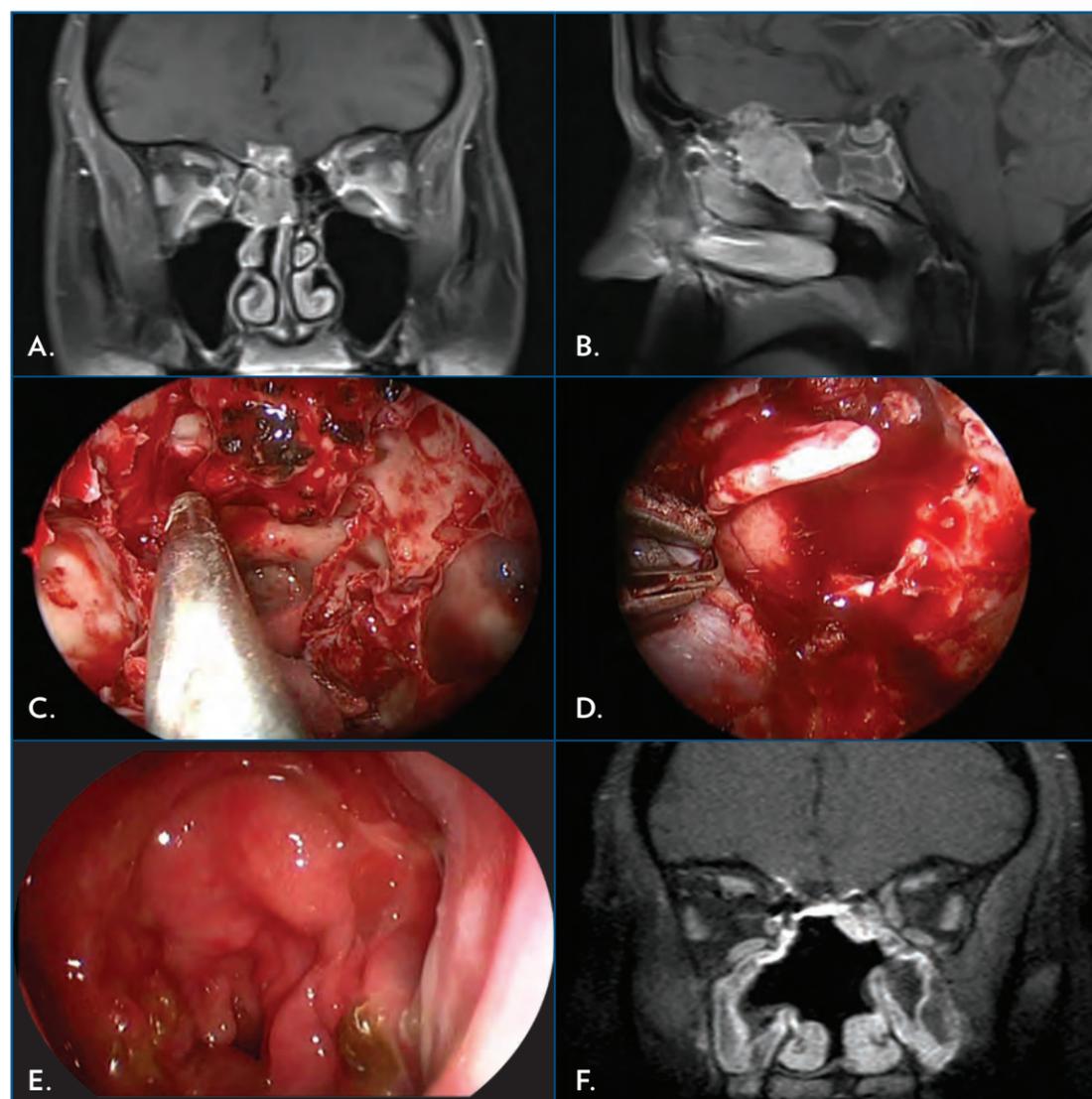
Her tumor was removed using a completely endoscopic approach with clear margins (Figure 4C-D). One significant area of concern was the lateral dural extension over the orbital roof. This required removal of lamina and mobilization of orbital soft tissue contents to obtain adequate margin. Reconstruction was performed with pedicled nasal septal flap and abdominal fat graft. Lumbar drain was not used. She was discharged, doing well on postoperative day three and underwent postoperative radiation therapy. Her postoperative endoscopy and MRI demonstrate a wide open cavity that permits long term endoscopic surveillance (Figure 4E-F).

### Future of the Skull Base Center

We are pleased with the success of our Skull Base Center to date and are excited for future growth. Our long-term goal is to be a nationwide leader in Skull Base patient care. Through the implementation of evidence-based treatment protocols, the latest intra-operative technology, and multi-disciplinary precision medicine, our team is prepared to provide exceptional treatment for this unique population. Please contact us at [skullbase@musc.edu](mailto:skullbase@musc.edu) if we can be of assistance to you or your patients. □

**Skull Base Pathology** is a heterogeneous group of diagnoses that occur at the junction of the sinonasal cavity/neck/ear and intracranial contents. Conditions our Skull Base Center treats include but are not limited to:

- Acoustic neuromas (vestibular schwannomas)
- Meningiomas
- Glomus tumors (paragangliomas)
- Cholesterol granulomas
- Sinonasal and other skull base tumors (such as inverted papilloma)
- Pituitary tumors
- Cerebrospinal fluid leaks
- Encephaloceles
- Superior semicircular canal dehiscence
- Petrous apicitis
- Neurofibromatosis Type II
- Petrous apex lesions
- Facial nerve and lower cranial nerve tumors
- Bell’s Palsy and other causes of facial paralysis
- Osteomyelitis
- Skull base chondrosarcoma



**Figure 4.** Identification and operative repair of an olfactory neuroblastoma. A-B: Coronal and sagittal MRI images of the lesion. C: Endoscopic view of skull base exposure from orbit to orbit with sella posteriorly and tumor attached to cribriform plate. D: View after removal of lamina and mobilization of orbital soft tissue contents. E: Post-operative endoscopic view of surgical field obtained in clinic. F: Post-operative MRI

**Ted R. McRackan, M.D., MSCR**, is the director of the Skull Base Center and medical director of the Cochlear Implant Program in the Department of Otolaryngology – Head and Neck Surgery. Dr. McRackan was born in Virginia and moved to Charleston to attend the College of Charleston. He received his medical degree from the Medical University of South Carolina and completed his residency at Vanderbilt University in Nashville, Tennessee. Afterward, he moved to Los Angeles for a fellowship in otology-neurotology and skullbase surgery at the House Ear Clinic.

Dr. McRackan’s clinical practice is focused on comprehensive management of ear, hearing, balance, and skull base disorders in adults and children. Specific areas of interest include, but are not limited to: cochlear implantation; chronic ear surgery (cholesteatoma, chronic otitis media); acoustic neuroma and other skull base lesions; otosclerosis; facial nerve disorders and tumors; endoscopic ear surgery; implantable hearing aids; and vertigo.

Dr. McRackan’s research is funded by the NIH and focuses on the development and application of novel measures to evaluate outcomes in individuals with hearing loss and cochlear implants to improve patient results (<https://education.musc.edu/ciqol>). He has published a comprehensive neurotology textbook and has written over 100 peer-reviewed articles and book chapters.



# 2020 Research Awards

## Federally Sponsored Awards\* \$5,539,966

### Judy R. Dubno, Ph.D. (PI)

Interdisciplinary Research Training in Otolaryngology and Communication Sciences

Type: NIH T32

Total Award: \$250,684

### Experimental & Clinical Studies of Presbycusis, Core A

Type: NIH

Total Award: \$367,190

### Experimental & Clinical Studies of Presbycusis, Core B

Type: NIH

Total Award: \$914,704

### Maximizing Speech Recognition under Adverse Listening Conditions

Type: NIH

Total Award: \$139,421

### Interdisciplinary Research Training in Otolaryngology and Communication Science

Type: NIH/NIDCD

Total Award: \$317,378

### Addressing Barriers to Adult Hearing Healthcare

Type: Duke University, Sub Award

Total Award: \$33,624

### Mark J. Eckert, Ph.D. (PI)

#### Experimental & Clinical studies of presbycusis - project 2

Type: DHHS/NIH/NIDCD

Total Award: \$378,564

#### Methods for Retrospective Multi-Site Research

Type: NIH/NICHHD

Total Award: \$322,777

### Evan M. Graboyes, M.D., MPH, FACS (PI)

#### Improving the Timeliness and Equity of Adjuvant Therapy Following Surgery for Head and Neck Cancer

Type: NIH K08

Total Award: \$133,274

#### A Novel Treatment Strategy for Body Image Disturbance in Head and Neck Cancer Survivors

Type: NIH R21

Total Award: \$192,201

### Kelly C. Harris, Ph.D. (PI)

#### A Novel Treatment Strategy for Body Image Disturbance in Head and Neck Cancer Survivors

Type: NIH/NIDCD

Total Award: \$421,314

#### Experimental & Clinical Studies of Presbycusis - Project 1, Core A&B

Type: DHHS/NIH

Total Award: \$451,656

#### Neural Determinants of Sound Encoding in the Aging Ear and Brain

Type: NIH/NIDCD

Total Award: \$373,750

### Kara Leyzac, AuD, CCC-A. Ph.D. (PI)

#### Functionally Important Features of the Electrically Stimulated Cochlea

Type: UofM subaward

Total Award: \$58,133

#### Reversing Synchronized Brain Circuits with Targeted Auditory-Somatosensory Stimulation to Treat Phantom Percepts

Type: UofM subaward

Total Award: \$12,098

#### Functionally Important Features of the Electrically Stimulated Cochlea

Type: UofM subaward

Total Award: \$11,898

### Theodore R. McRackan, M.D., MSCR (PI)

#### A New Quality of Life Instrument to Assess Functional Outcomes of Cochlear Implantation in Adults

Type: NIH

Total Award: \$201,636

### Jennifer K. Mulligan, Ph.D. (PI)

#### Role of Vitamin D Metabolism in CRS

Type: NIH

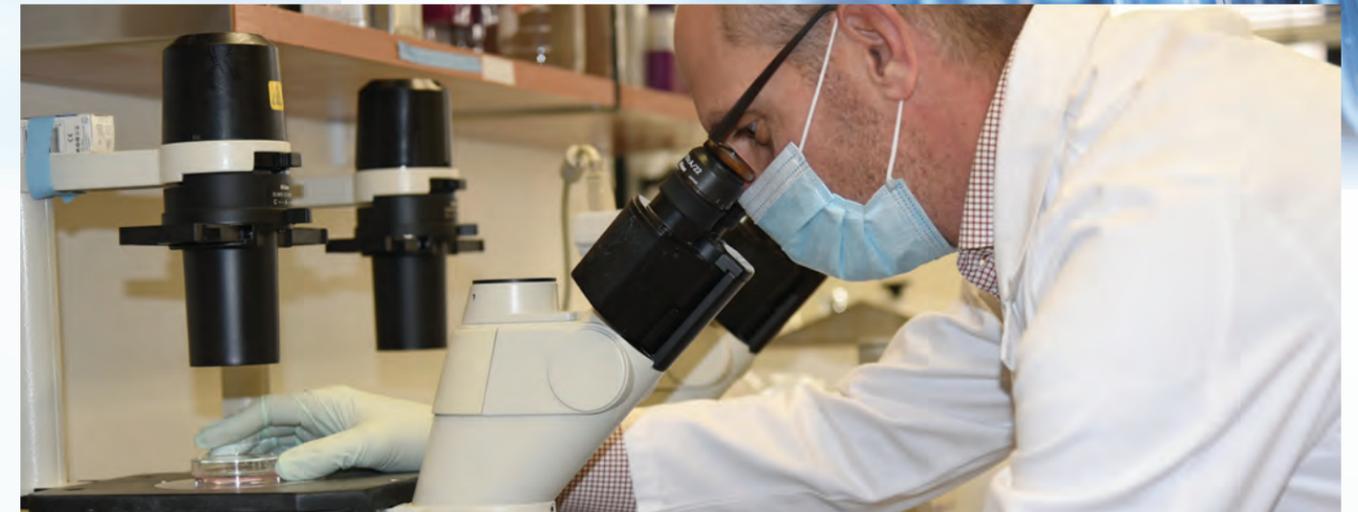
Total Award: \$445,190

### David M. Neskey, M.D., MSCR, FACS (PI)

#### Defining the role of CD26 in Checkpoint Blockaded Induced Tumor Immunity

Type: R21

Total Award: \$224,250



David M. Neskey, M.D., MSCR, FACS, Associate Professor, Head & Neck Oncology

### Krishna G. Patel, M.D., Ph.D. (PI)

#### Craniofacial Anomalies and Cleft Lip and Palate

Type: DHEC

Total Award: \$52,549

### Zachary M. Soler, M.D., MSc (PI)

#### Determinants of Olfactory Dysfunction in Chronic Rhinosinusitis

Type: NIH

Total Award: \$237,674

## Professional Foundation / Society Awards\* \$232,638

### Evan M. Graboyes, M.D., MPH, FACS (PI)

#### Doris Duke PERK Leadership Award

Type: Doris Duke Charitable Foundation

Total Award: \$58,320

### Theodore R. McRackan, M.D., MSCR (PI)

#### Development of Clinically and Research Applicable Quality of Life Instruments for Adult Cochlear Implant Population

Type: American Cochlear Implant Alliance

Total Award: \$150,000

### Habib G. Rizk, M.D., MSc (PI)

#### Assessing the Efficacy of a Serotonin and Norepinephrine Reuptake Inhibitor for Improving Meniere's Disease Outcomes

Type: AHRF

Total Award: \$24,318

## Industry Sponsored Awards\* Expended \$353,201

### Theodore R. McRackan, M.D., MSCR (PI)

#### Treatment of Eustachian Tube Dysfunction (Etd) and Facial Pain with Combined Acoustic Vibration and Oscillating Expiratory Pressure

Type: Healthy Humming LLC

Total Award: \$23,750

### Ted A. Meyer, M.D., Ph.D. (PI)

#### Use of Novel Sinusonic Evic For Prevention of Community Acquired Upper Respiratory Infection (Uri)

Type: Healthy Humming LLC

Total Award: \$35,837

### Ashli K. O'Rourke, M.D. (PI)

#### Post-Market Retrospective STUDY of the Renu Soft Tissue (Volumizing) Implant (RENU Voice) in the Treatment of Vocal Fold Medialization and Vocal Fold Insufficiency

Type: Stryker Corp

Total Award \$18,350

### Rodney J. Schlosser, M.D. (PI)

#### ClariFix Rhinitis Randomized Controlled Trial

Type: Stryker Corp

Total Award: \$275,263

\*All awards reported are active for calendar year 2020

# Olfactory Research at MUSC: Unravelling the Epidemiology, Impacts, and Pathophysiology of Chronic Smell Loss

Zachary M. Soler, M.D., MSc

COVID-19 thrust olfactory dysfunction (OD) into the spotlight, as otherwise healthy individuals worldwide experienced smell loss on an unprecedented scale<sup>1</sup>. However, chronic olfactory loss was a common problem prior to the pandemic, one that traditionally has received very little attention in the general community or by medical providers. With ongoing support from the National Institute on Deafness and Other Communication Disorders (NIDCD), our research program has been dedicated to better understanding chronic OD. Over the last year, these efforts have attempted to better understand the epidemiology, disease impacts, and underlying pathophysiology of chronic OD.

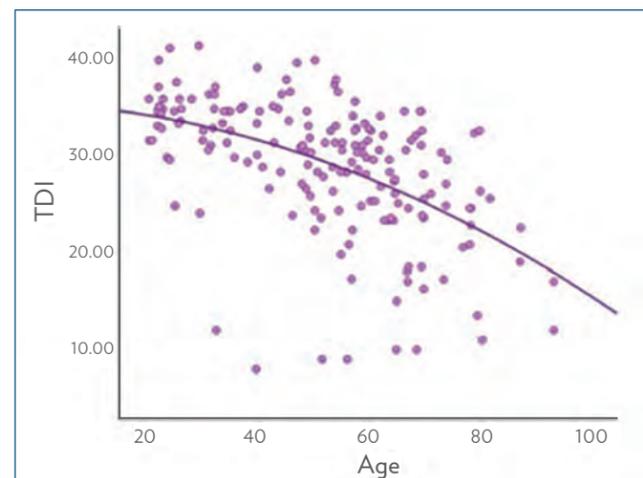


Figure 1: Correlation between objective olfaction and age, showing that olfaction worsens as age increases. TDI=combined threshold, discrimination, and identification score from Sniffin' Sticks testing.

## Epidemiology

Although there has been an explosion of COVID-related olfactory research in the last year, chronic OD predated COVID and will persist once vaccination and herd immunity eliminate largescale spread of SARS-CoV-2.

On a population level, age-related olfactory dysfunction contributes to the majority of olfactory loss, particularly in those over age 50. In a community-based sampling of 176 healthy adults, we found that 53% of subjects demonstrated olfactory loss using comprehensive psychophysical smell

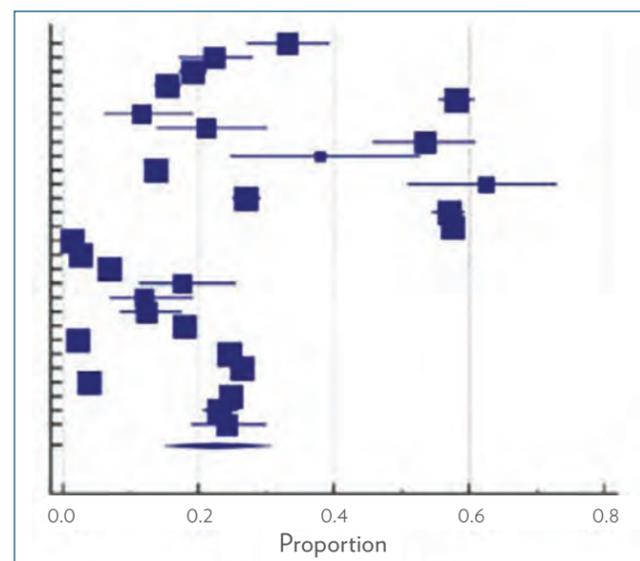
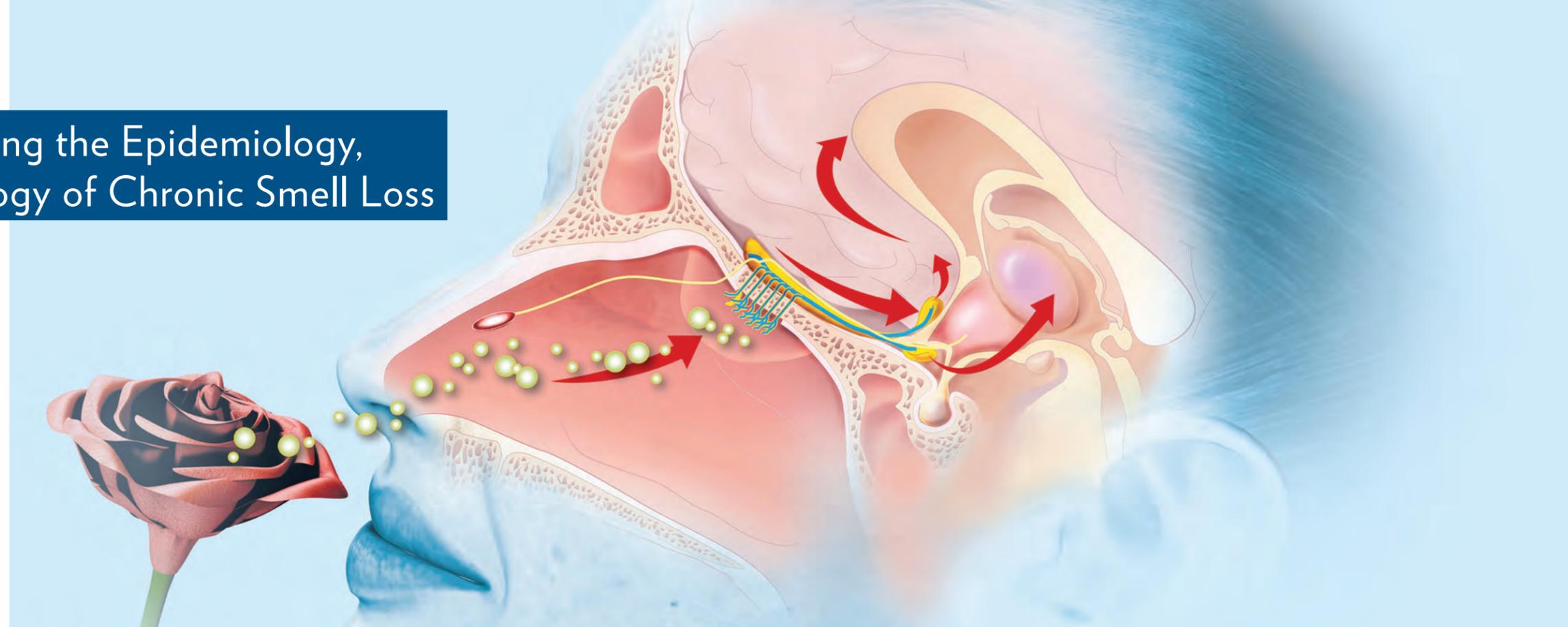


Figure 2: Meta-analysis of the proportion of healthy subjects with objective olfactory loss across published studies. Squares represent proportions for individual studies and the diamond represents the weighted proportion across all studies

testing, with age as the strongest independent predictor (Figure 1)<sup>2</sup>. We also performed a systematic review and meta-analysis of 175,073 subjects, which estimated OD in 22.2 percent (Figure 2)<sup>3</sup>. Typically, objective olfactory loss is underestimated by patients as a slow decline in smell and

may be less perceptible. As otolaryngologists, we are most likely to encounter OD in the setting of chronic rhinosinusitis (CRS). CRS is the most common cause of OD in individuals younger than age 50. As part of a multi-center study, we have found OD in 73 percent of patients with CRS, with polyp status, asthma, diabetes, and age driving the likelihood of smell loss<sup>4</sup>. Although variability exists across studies, the bottom line is that chronic OD is a problem for hundreds of millions of individuals worldwide and worsens with age and presence of CRS.

## Impacts

Olfaction has often been called the “forgotten sense”, as impacts of smell loss are usually trivialized in the popular consciousness, at least compared to vision or hearing. In some ways, the COVID pandemic has shattered this misconception, as millions of otherwise healthy young adults have now experienced smell loss firsthand. In community dwelling older adults, we found a significant correlation between OD and the De Jong Gierveld (DJG) loneliness scale, suggesting that older adults with OD are more likely to be lonely compared to those with normal smells<sup>5</sup>. Although this study was not designed to determine causality, one might hypothesize that OD could cause loneliness by impacting the flavor and enjoyment of food. Quarantines have taught us the importance that gathering together with

friends over a good meal has for our mental wellbeing. Our recent work has shown that for every one-point decrease in orthonasal olfactory threshold, the odds of impaired eating-related quality-of-life (QOL) increased by 1.9 times (OR 1.85; 95 percent CI, 1.14 to 3.00;  $p = 0.013$ )<sup>6</sup>. Using blinded food tasting, we recently found that subjects with OD are less likely to correctly identify food items and less likely to rate foods as enjoyable<sup>7</sup>. We have additionally shown that OD is associated with impaired nutritional intake, as measured by the Diet History Questionnaire III (DHQIII), a standardized and validated tool for nutritional assessment<sup>8</sup>. Considering the QOL impacts of OD, it should not be surprising that OD was rated as the number two (out of 22) most important symptom in patients with CRS undergoing surgical treatment<sup>9</sup>.

## Pathophysiology

Although epidemiology and quality of life impacts are critical to defining the scope of the problem, we are most interested in understanding the mechanisms through which OD occurs. When it comes to pathophysiology, most of our focus has been understanding why OD occurs in some patients with CRS but not others. In order to help answer this question, we have collected mucus from the olfactory cleft of patients

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## Olfaction Research continued....

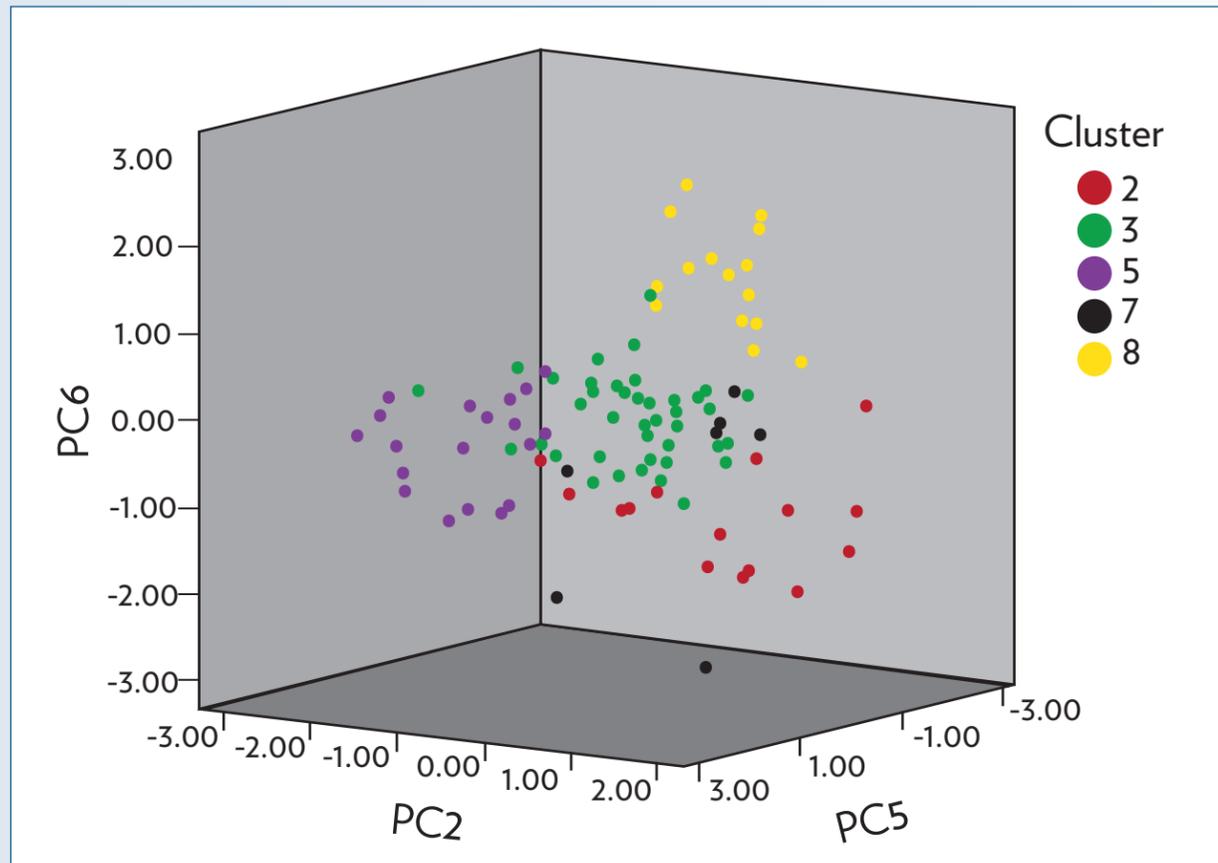


Figure 3: Three-dimensional representation of CRS clusters defined by olfactory cleft inflammatory proteins. Each color represents a unique inflammatory endotype. PC=principal component.

with CRS and simultaneously tested olfaction. We found a number of inflammatory proteins significantly correlate with olfaction, including IL5, IL13, and IgE among others<sup>10</sup>. Of note, these are the same targets for monoclonal antibodies which have been showing in recent clinical trials to improve olfaction in patients with CRS and nasal polyps. We have recently utilized expanded panels of these olfactory cleft biomarkers to cluster patients into olfactory endotypes that reflect underlying pathophysiology (Figure 3)<sup>11</sup>. We have also performed proteomic profiling of olfactory cleft mucus from patients with CRS and controls, detailing well over a thousand unique proteins present in olfactory mucus<sup>12</sup>. Significant differences were seen across groups, particularly for individual proteins likely to be involved in odorant transport and metabolism (Figure 4). These findings are promising steps that one day may help guide treatment decision-making. □

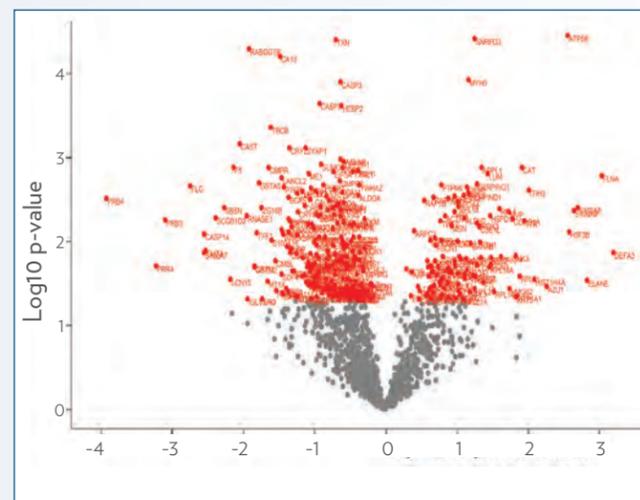


Figure 4: Volcano plot comparing olfactory cleft mucus proteins levels between cases with CRS and controls. Those proteins in red are significantly different between groups.

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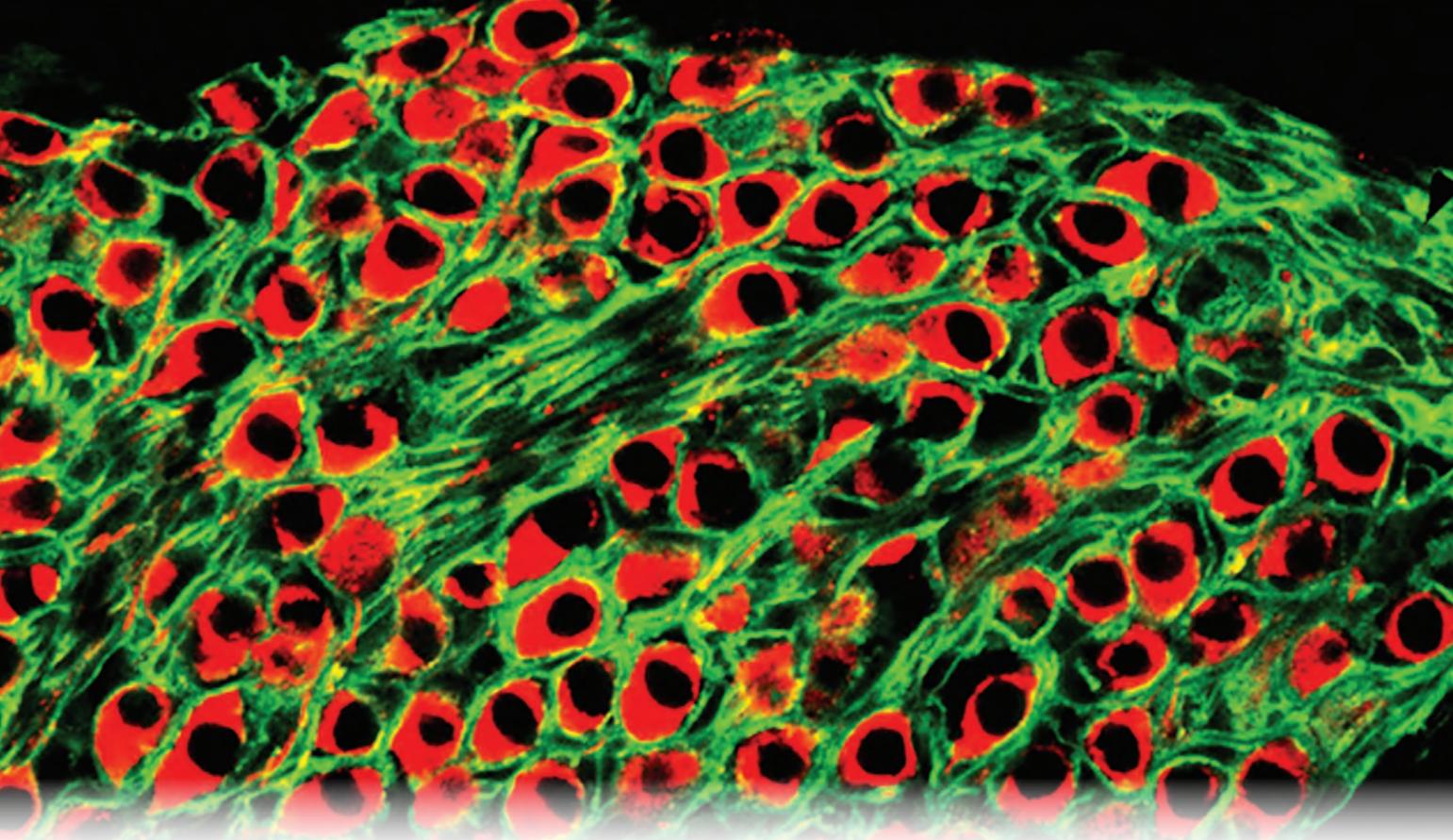
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- In Press *Journal of Allergy and Clinical Immunology*.
- In Press *International Forum of Allergy and Rhinology*.



Zachary M. Soler, M.D., MSc, joined the MUSC Sinus Center in 2011. Originally from coastal Florida, Dr. Soler attended medical school at Wake Forest University, followed by a residency in otolaryngology - head and neck surgery at Oregon Health and Science University. He then completed a fellowship dedicated solely to rhinology and endoscopic sinus surgery at Harvard Medical School. After fellowship, Dr. Soler spent an additional year at the Harvard School of Public Health, earning a Master's Degree in epidemiology.

Dr. Soler's practice is dedicated primarily to diseases of the nose, sinuses, and skull base. He treats adults and children with a wide range of conditions, ranging from common allergies and sinusitis to skull base tumors and CSF leaks. He has particular expertise with difficult-to-manage cases of sinusitis, revision sinus surgery, and surgical treatment of sino-nasal tumors.

Dr. Soler has authored over 180 manuscripts and book chapters related to otolaryngology and rhinology. His research focus is on optimizing clinical outcomes after medical and surgical treatment of chronic sinusitis. He is a principal investigator on several large studies funded through the National Institutes of Health and the American Rhinologic Society. He is board certified through the American Board of Otolaryngology and a member of the American Rhinologic Society.



## Novel Approaches to Characterize Age-Related Changes in Auditory Nerve Function

Kelly C. Harris, Ph.D.

Hearing loss is estimated to occur in approximately 30 million Americans. Age is a strong predictor of hearing loss, which increases with advancing age from approximately one-third of adults 60 to 70 years of age, to 80 percent of adults 85 and older. Age-related hearing loss in humans is complex because many factors, in addition to aging, can produce hearing loss in older adults, including the accumulated effects of a lifetime of exposure to noise or ototoxic drugs, or certain diseases. A significant obstacle in the development of targeted treatments for age-related hearing loss is the multiple sources of pathologies in the auditory system, which makes it difficult to isolate the mechanism(s) that contribute to age-related auditory deficits and their impact on communication in an individual. Three primary sites of pathology, sensory (hair) cells, stria vascularis in the cochlea, and auditory nerve fibers, underlie age-related decreases in detection (increases in pure-tone thresholds) and suprathreshold auditory function, such as complex sound processing and understanding of speech. Ongoing studies in the Hearing Research Program's National Institutes of Health funded Clinical Research Center (P50) include several research projects in both laboratory animals

and humans to characterize auditory pathology underlying changes in hearing function with increasing age. Here we focus on methods newly developed to better characterize neural presbycusis, defined as a loss or dysfunction of auditory nerve fibers. Growing evidence suggests that auditory nerve dysfunction/loss may occur without changes in detection thresholds as indicated by the audiogram and may contribute to deficits in suprathreshold auditory function. Auditory nerve dysfunction or loss can result from one or more interrelated factors. First, animal models and post-mortem studies of human temporal bones suggest that aging alone leads to a systematic loss of auditory nerve fibers, known as primary neural degeneration. Second, deficits in the cochlear lateral wall (stria vascularis) and the related reduction in the endocochlear potential can lead to

Image above was modified from Jyothi V, Li M, Kilpatrick LA, Smythe N, LaRue AC, Zhou D, Schulte BA, Schmiedt RA, Lang H. Unmyelinated auditory type I spiral ganglion neurons in congenic Ly5.1 mice. *J Comp Neurol*. 2010 Aug 15;518(16):3254-71. doi: 10.1002/cne.22398. PMID: 20575058; PMCID: PMC2897057.

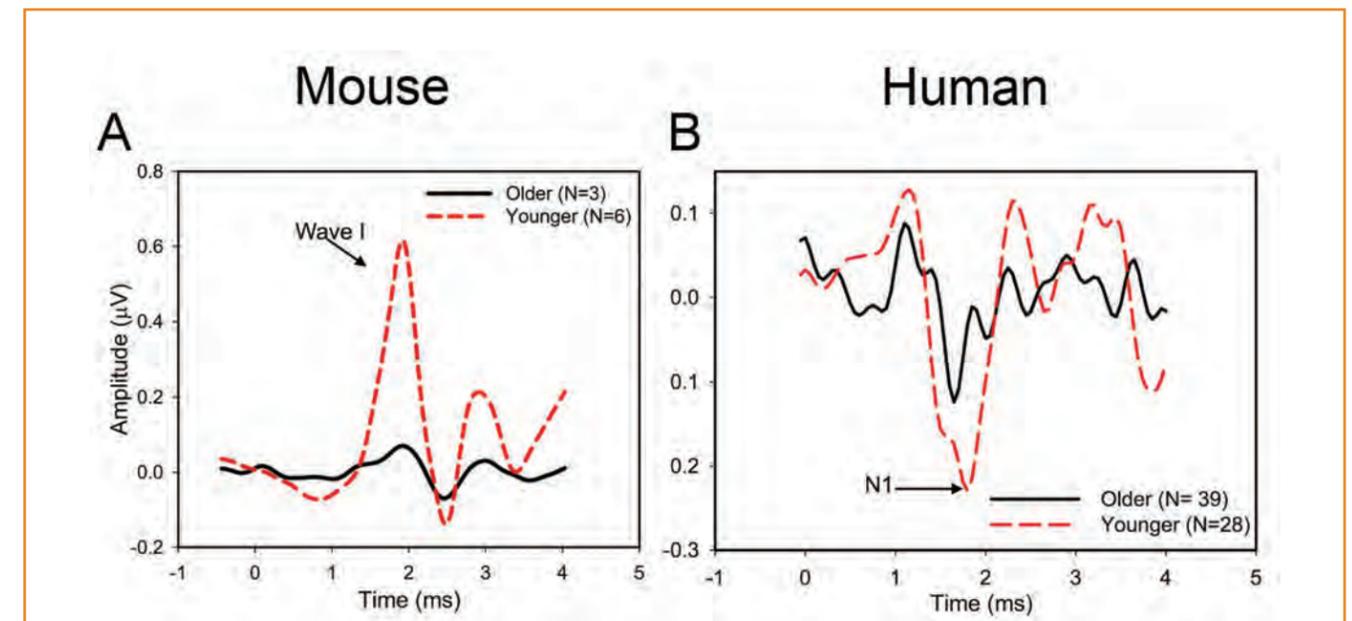


Figure 1. Age-related differences in auditory nerve function across species. A. The amplitude of ABR Wave I was reduced in older compared to younger CBA/CaJ mice (11 kHz tone-burst, 85 dB SPL). B. The amplitude of CAP N1 was reduced in older compared to younger adult human subjects (100  $\mu$ S click, 110 dB pSPL). Figure adapted from Eckert et al., (2020). Translational and Interdisciplinary Insights into Presbycusis: A Multidimensional Disease. *Hear Res*. PMID: 33189490 DOI: 10.1016/j.heares.2020.108109

poorer auditory nerve function, despite preserved auditory nerve fibers. Third, damage or loss of sensory (hair) cells in the cochlea can have subsequent effects on auditory nerve fiber structure and function, or secondary neural degeneration. Although the prevalence of auditory nerve loss in older adults is unknown, accumulating evidence from human temporal bones suggests that the number of individuals with auditory nerve loss exceeds those with hearing loss due to hair cell damage.

Auditory nerve dysfunction prior to or in addition to the loss of auditory nerve fibers can result from several factors, including the loss of synapses between inner hair cells and the auditory nerve and myelin abnormalities that occur prior to significant loss of spiral ganglion neurons and auditory nerve fibers. Despite these now well-established findings related to age-related structural deficits in the auditory nerve in animal models, reliable measures to characterize auditory nerve function in humans remain limited.

Clinical audiologic test batteries typically include several measures of Wave V of the auditory brainstem response (ABR), such as ABR Wave V amplitude, latency, and threshold. Wave V of the ABR is thought to originate

from the lateral lemniscus in the central auditory system. An important consideration in the interpretation of Wave V measures from older adults is the effect of age-related changes in the cochlea, auditory nerve, and brainstem. A more specific measure of auditory nerve function is the compound action potential (CAP) or Wave I of the ABR, a direct measure of summated auditory nerve activity. Reduced CAP response amplitudes for higher level signals have been observed in older mice raised in quiet environments and older adults (Figure 1A and 1B, respectively). Although reduced CAP amplitudes appear consistent with age-related deficits in auditory nerve function, more information is needed to better characterize auditory nerve pathology.

One difficulty in characterizing deficits in auditory nerve function is the heterogeneity of response properties of auditory nerve fiber types. This biodiversity is crucial for encoding complex auditory signals and supporting auditory perception over a wide dynamic range. Auditory nerve fibers are typically grouped into subtypes based on response properties, and in humans are subdivided into high

## Hearing Research continued....

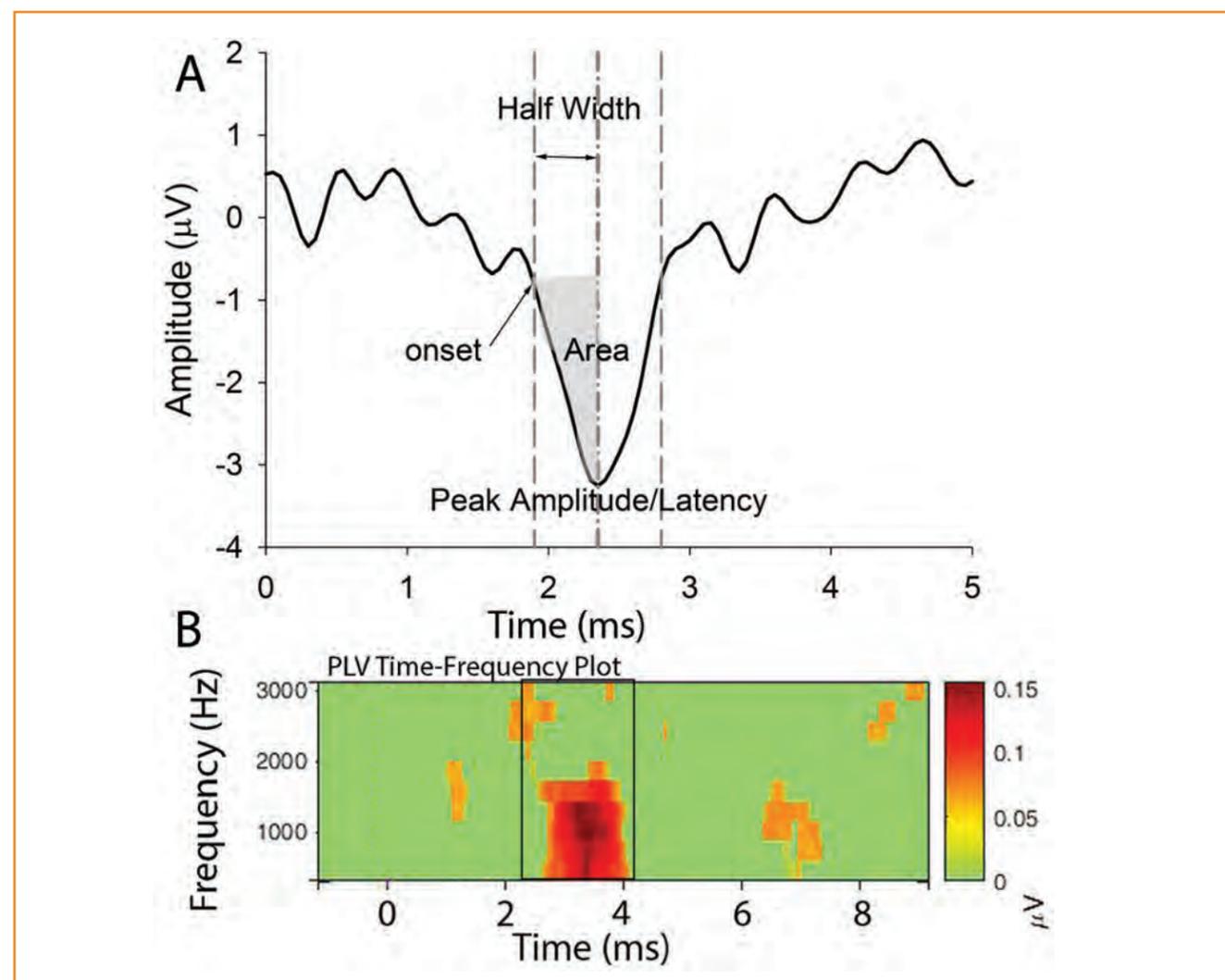


Figure 2. Multi-metric approach to characterize age-related loss of auditory nerve fibers. A. A representative compound action potential (CAP) response from a younger adult illustrating the 5 time-domain CAP metrics and phase locking value (PLV): Peak amplitude ( $\mu\text{V}$ ), which is peak-to-baseline amplitude calculated in reference to a pre-stimulus baseline; Peak latency (ms) defined as latency of the peak amplitude; Onset latency (ms), which is 90% fractional peak latency at N1 onset; Half-width latency (ms), which is time from onset latency to peak latency; and Area ( $\mu\text{V}\cdot\text{ms}$ ), calculated as the numerical integration from N1 onset to peak. B. PLV time-frequency plot. Time-frequency analysis was used to estimate PLV of the CAP (via short-term Fast Fourier Transform (FFT) in EEGLab) within linearly spaced frequencies from 625 to 3120 Hz. The strength of the PLV above baseline (green) is indicated by color (orange, red). PLV was extracted by averaging across a 2-ms time window surrounding the peak of the CAP and between 625 and 3120 Hz (black rectangle). Adapted from Harris et al., (2018). Complementary metrics of human auditory nerve function derived from compound action potentials. *J Neurophysiol* 119, 1019-1028. PMID: PMC5899314. DOI: 10.1016/j.jneumeth.2020.108937

and low spontaneous rate (SR) fibers. High-SR fibers have low thresholds, recover quickly from prior stimulation, but saturate at lower intensity levels. Due to their low thresholds, high-SR fibers are the primary contributors to detection thresholds (pure-tone thresholds on an audiogram) or ABR thresholds. In contrast, low-SR fibers have higher thresholds, recover more slowly from prior stimulation, and have a wide dynamic range. As these are higher threshold fibers, they do not contribute to auditory detection thresholds, but are believed to be important for suprathreshold auditory processing and speech recognition. Accumulating evidence suggests that low-SR fibers are more vulnerable to effects of age and noise exposure.

Our lab has developed a new CAP multi-metric approach to characterize age-related loss or inactivity of low-SR fibers based on differences in the response properties of auditory nerve subtypes, how different fiber types are predicted to respond with increasing signal level, and how neural pathology may differentially affect CAP metrics (Figure 2A). Two primary factors related to auditory nerve pathology can affect CAP response amplitudes for higher level signals and growth of the CAP with increasing signal level: (1) a decrease in the recruitment of neurons (fewer neurons responding to increasingly higher signal levels) or (2) neural dyssynchrony (fewer time-locked responses or less synchronous activity). These combined factors are predicted to give rise to differential patterns across CAP metrics.

As neural dyssynchrony is thought to contribute to poorer auditory processing for older adults, and may help identify deficits in neural structure, we have included a measure of neural synchrony across CAP signal presentations, termed the phase locking value (PLV). A loss of auditory nerve fibers and auditory nerve dyssynchrony will both result in decreased CAP amplitudes for higher signal levels. However, auditory nerve dyssynchrony will result in poorer PLV and wider CAP responses (Figure 2B) than a loss of auditory nerve fibers or a decrease in recruitment of neurons. As predicted, we have observed large individual differences across CAP metrics and PLV in both younger and older adults, with older adults showing smaller CAP amplitudes and more dyssynchronous responses at higher signal levels than younger adults. This is consistent with the assumption that aging results in a loss of low-SR, higher threshold fibers and that this loss is compounded by a loss of neural synchrony.

To validate these methods and identify the extent to which specific neural pathologies, including auditory nerve loss, myelin deficiency, or cochlear pathology, explain CAP responses, we recently translated these new methods from the 'bedside' back to the 'bench' to measure CAP metrics and PLV in mouse models with known pathology. As new treatments become available, comprehensive assessment of the effects of cochlear and auditory nerve pathology on auditory nerve function is a critical first step in identifying potential targets for intervention. □



Kelly C. Harris, Ph.D., is an Associate Professor in the Hearing Research Program in the MUSC Department of Otolaryngology-Head and Neck Surgery. Her research focuses on age-related changes in the auditory system from the cochlea to the cortex. Her research is supported by grants from the National Institute of Health (NIH)/National Institute on Deafness and Other Communication Disorders (NIDCD).

# Otolaryngology - Head & Neck Surgery Providers

## Otology & Neurotology



**Paul R. Lambert, M.D.**  
Professor and Chairman  
M.D.: Duke University  
Residency: UCLA  
Fellowship: House Ear Institute



**Ted A. Meyer, M.D., Ph.D.**  
Professor, Director, Otology - Neurotology, Otolaryngology Residency  
Program Director, Neurotology Fellowship Program Director  
M.D. & Ph.D.: University of Illinois  
Residency: Indiana University  
Fellowship: University of Iowa



**Theodore R. McRackan, M.D., MSCR**  
Associate Professor, Director, Cochlear Implant Program,  
Director, Skull Base Surgery Center  
M.D.: MUSC  
Residency: Vanderbilt University Medical Center  
Fellowship: House Ear Institute



**Habib G. Rizk, M.D., MSc**  
Associate Professor, Director, Vestibular Program  
M.D.: Saint Joseph University, Beirut, Lebanon  
Residency: Saint Joseph Univ. and Hotel-Dieu de France Hospital,  
Beirut, Lebanon  
Fellowship: MUSC



**Mary Ann Howerton, PA-C**  
Physician Assistant  
MSPAS: MUSC



**Ryan S. Marovich, MPAS, PA-C**  
Physician Assistant  
MPAS: Gannon University

## Head & Neck Oncology



**Terry A. Day, M.D.**  
Professor and Director, MUSC HN Tumor Program  
Wendy and Keith Wellin Chair in Head & Neck Surgery  
M.D.: University of Oklahoma  
Residency: LSU-Shreveport  
Fellowship: UC Davis



**Evan M. Graboyes, M.D., MPH, FACS**  
Assistant Professor  
M.D. & Residency: Washington University School of Medicine  
Fellowship: MUSC



**Joshua D. Hornig, M.D.**  
Associate Professor  
Director, Microvascular Surgery and  
Functional Outcomes  
M.D. & Residency: University of Alberta  
Fellowship: MUSC



**Eric J. Lentsch, M.D., FACS**  
Professor  
M.D. & Residency: University of Louisville  
Fellowship: MD Anderson



**David M. Neskey, M.D., MSCR, FACS**  
Associate Professor  
M.D.: Albany Medical College  
Residency: University of Miami  
Fellowship: MD Anderson



**Hannah Feltner, PA-C**  
Certified Physician Assistant  
MPAS: Augusta University College of Allied  
Health Sciences



**Sara F. Jasper, ACNP-BC**  
Acute Care Nurse Practitioner  
MSN: Columbia University



**Melissa A. Lee, PA-C**  
Physician Assistant  
MPAS: University of Texas Medical Branch



**Caitlin L. Mengler, RN, ACNP-BC**  
Acute Care Nurse Practitioner  
MSN: New York University



**Kiely M. St. Germain, FNP-C, MSN**  
Family Nurse Practitioner  
MSN: University of Maine School of Nursing

## Rhinology & Sinus Surgery



**Rodney J. Schlosser, M.D.**  
Professor and Director,  
Rhinology and Sinus Surgery  
M.D.: Mayo Clinic  
Residency: University of Virginia  
Fellowship: University of Pennsylvania



**Zachary M. Soler, M.D., MSc**  
Associate Professor  
M.D.: Wake Forest University  
Residency: Oregon Health and Science University  
Fellowship: Harvard Medical School



**TK Wall, DNP, NP-C**  
Family Nurse Practitioner  
DNP: MUSC

## Evelyn Trammell Institute for Voice and Swallowing



**Lucinda A. Halstead, M.D.**  
Associate Professor  
Medical Director, ETIVS  
M.D.: George Washington University  
Residency: New England Medical Center, Boston



**Ashli K. O'Rourke, M.D.**  
Associate Professor and Director, Laryngology  
M.D.: Medical College of Georgia  
Residency: University of Virginia  
Fellowship: Medical College of Georgia



**Drasti P. Smyre MSPAS, PA-C**  
Certified Physician Assistant  
MSPAS.: MUSC

## Facial Plastic & Reconstructive Surgery



**Krishna G. Patel, M.D., Ph.D.**  
Professor, Director, FPRS  
Director, Craniofacial Anomalies and Cleft Lip/Palate Team  
M.D. & Ph.D.: Medical College of Georgia  
Residency: UNC Chapel Hill  
Fellowship: UC Davis



**David S. Chen, M.D.**  
Instructor  
M.D.: Johns Hopkins University School of Medicine  
Residency: Johns Hopkins University School of Medicine  
Fellowship: Oregon Health & Science University



**Judith M. Skoner, M.D.**  
Assistant Professor  
M.D.: University of South Carolina  
Residency: MUSC  
Fellowship: Oregon Health and Science University



**Emily Kueser, MSPAS, PA-C**  
Certified Physician Assistant  
MSPAS: MUSC

## Otolaryngology - Head & Neck Surgery Providers

### Pediatric Otolaryngology



**David R. White, M.D.**  
Professor and Director, Pediatric Otolaryngology  
MUSC Children's Health Surgeon in Chief  
M.D.: MUSC, Residency: UNC Chapel Hill  
Fellowship: Cincinnati Children's



**William W. Carroll, M.D.**  
Assistant Professor  
M.D.: MUSC  
Residency: MUSC  
Fellowship: University of Minnesota



**Clarice S. Clemmens, M.D.**  
Assistant Professor, Pediatric Otolaryngology  
Fellowship Director  
M.D.: MUSC  
Residency: Hospital of the University of Pennsylvania  
Fellowship: Children's Hospital of Philadelphia



**Phayvanh P. Pecha, M.D.**  
Assistant Professor  
M.D.: University of Minnesota  
Residency: University of Utah  
Fellowship: MUSC



**Helen F. Kulseth, PA-C**  
Pediatric Physician Assistant  
MSPA: MUSC



**Lydia B. Redden, CPNP-AC**  
Acute Care Pediatric Nurse Practitioner  
MSN: University of South Alabama



**Jana L. Wheeler, PPCNP-BC**  
Pediatric Nurse Practitioner  
MSN: Yale University  
DNP: MUSC

### Maxillofacial Prosthodontics



**Betsy K. Davis, D.M.D., MS**  
Professor, Medical Director, Maxillofacial  
Prosthodontics  
D.M.D.: MUSC  
Residency: University of Iowa  
Fellowship: M.D. Anderson; UCLA



**J Rhet Tucker, D.M.D.**  
Assistant Professor  
D.M.D.: University of Pennsylvania  
Residency: U.S. Army  
Fellowship: MD Anderson

### Clinical Trials & Innovative Medicines



**Shaun A. Nguyen, M.D., FAPCR**  
Professor and Director,  
Clinical Research  
M.D. & Residency: University College London  
Fellowship: MUSC

### Audiology



**Kimberly A. Orr, AuD, CCC-A**  
Director, Audiology  
MA: Ohio State University  
AuD: A.T. Still University



**Kara Leyzac AuD, PhD, CCC-A**  
Director, CI Program  
Assistant Professor  
AuD & Ph.D.: University of Maryland



**Arielle Abrams, AuD, CCC-A**  
Clinical Instructor  
AuD: University of North Carolina at Chapel Hill



**Hannah R. Burrick, AuD, CCC-A**  
Clinical Instructor  
AuD: Washington University in St. Louis



**Elizabeth Camposeo, AuD, CCC-A**  
Assistant Director, CI Program  
Clinical Assistant Professor  
AuD: Northwestern University



**Lauren L. Costello, AuD, CCC-A**  
Clinical Instructor  
AuD: Northeast Ohio AuD Consortium  
(University of Akron)



**Meredith L. Duffy, AuD, CCC-A**  
Clinical Director of Hearing Rehabilitation  
AuD: University of Connecticut School of Medicine



**Kaylene A King, AuD**  
Clinical Instructor  
AuD: University of North Carolina at Chapel Hill



**Claire Hauschildt, AuD, CCC-A**  
Clinical Instructor  
AuD: Purdue University



**Elizabeth A. Poth, AuD, CCC-A**  
Instructor  
MS: UNC Chapel Hill  
AuD: A.T. Still University



**Nicole Ritter, AuD, CCC-A**  
Clinical Instructor  
AuD: Ohio University



**Michelle L. Sewell, AuD, CCC-A**  
Clinical Instructor  
AuD: UNC Chapel Hill



**Christine C. Strange, AuD, CCC-A**  
Instructor  
Clinical Director, Vestibular Program  
MA: SUNY Plattsburgh  
AuD: A.T. Still University

# Otolaryngology - Head & Neck Surgery Research Faculty

Welcome to MUSC!

## Hearing Research



**Judy R. Dubno, Ph.D.**  
Professor, Director, MUSC Hearing Research Program  
Ph.D.: City University of New York



**Kelly C. Harris, Ph.D.**  
Associate Professor  
Ph.D.: University at Buffalo



**Jayne B. Ahlstrom, M.S.**  
Instructor  
M.S.: Vanderbilt University



**Lois J. Matthews, M.S.**  
Instructor  
M.S.: Purdue University



**Mark A. Eckert, Ph.D.**  
Professor  
Ph.D.: University of Florida



**Richard A. Schmiedt, Ph.D.**  
Professor Emeritus  
Ph.D.: Syracuse University



**Kenneth I. Vaden, Jr., Ph.D.**  
Research Assistant Professor  
Ph.D.: University of California, Irvine



**Brent A. Wilkerson, Ph.D.**  
Assistant Professor  
Ph.D.: MUSC

## ENT 2020-21 Interns



**Jenna H. Barengo, M.D.** was raised in Marietta, OH. She graduated summa cum laude from the University of Pittsburgh, receiving a BSE in Bioengineering. Before medical school, she spent a year in Pittsburgh working in domestic violence education. She then earned her M.D. from the University of Cincinnati, and was inducted into the Gold Humanism Honor Society. Jenna enjoys homebrewing, fantasy football, board and video games, and spending time with her husband Eric and dog Charlie.



**James D. Sullivan, M.D.** is from Roswell, Georgia and graduated from the University of Georgia Honors College summa cum laude with a double major in Biology and Psychology. He then attended medical school at the Medical College of Georgia. In his free time, James enjoys playing basketball, watching UGA football, going to the beach, and trying new restaurants.



**Corin M. Kinkhabwala, M.D.** hails from Pelham, NY and graduated with honors from Colgate University with a degree in music composition. He later attended Columbia University's post-bacc program before receiving his M.D. from Albert Einstein College of Medicine in New York City. Corin enjoys playing tennis with his partner, Christina. In addition, he loves to play music, basketball and is doing his best to survive as a Jets and Knicks fan.

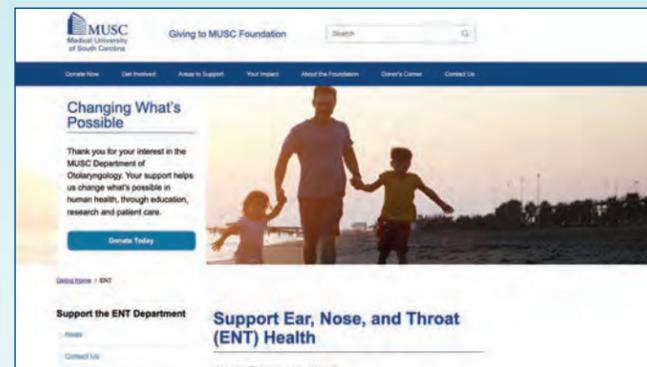


**Elizabeth R. Walker, M.D., MSCR,** from Atlanta, GA, graduated from the University of Virginia as a distinguished major in Human Biology. She returned to Atlanta to attend Emory University and was inducted into the Alpha Omega Alpha Honor Society. She received NIH grant funding to support her MS in Clinical Research and research in racial disparities in surgical outcomes in the Southeast. She graduated in 2020 and was thrilled to match at MUSC. Liz enjoys kayaking with her husband Andy, going to the beach with her dog Scratch, and exploring Charleston.

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## Otolaryngology Fellowships

**MUSC offers otolaryngology fellowships in six subspecialties.** In addition to an extensive surgical experience, fellows benefit from a multidisciplinary approach by participating in outpatient clinics, rounds, and didactic conferences.

- Facial Plastic & Reconstructive Surgery
- Head and Neck Oncology and Microvascular Reconstruction
- Laryngology
- Neurotology
- Pediatric Otolaryngology
- Rhinology and Endoscopic Sinus/Skull Base Surgery

In addition to an extensive surgical experience, fellows benefit from a multidisciplinary approach by participating in outpatient clinics, rounds, and didactic conferences.



Learn about our fellowship programs on our website at [musc.edu/ent](http://musc.edu/ent)

## SinuSonic Clinical Trials for Nasal Congestion, Eustachian Tube Dysfunction, and Prevention of Viral URIs

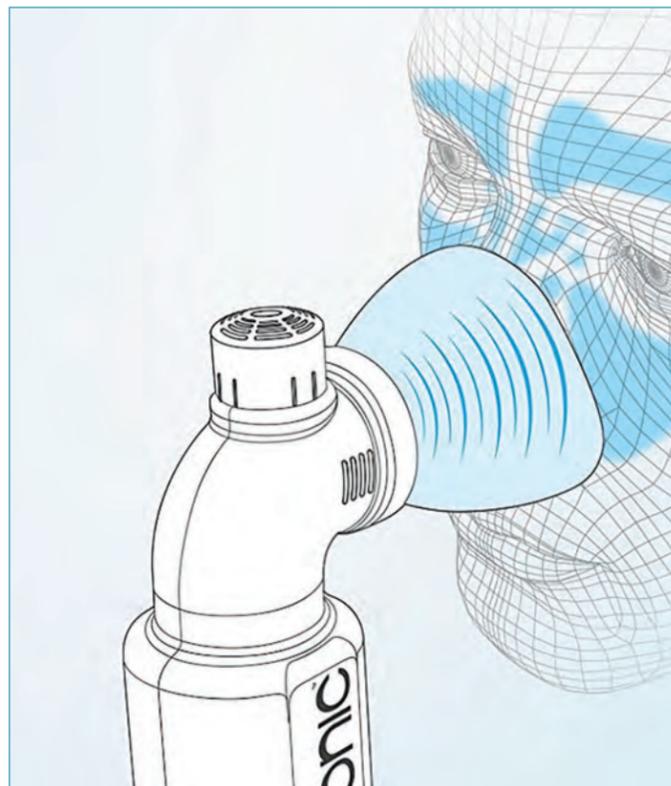
Shaun A. Nguyen, M.D., FAPCR

Division of Clinical Trials and Innovative Medicines

For decades, pulmonary physicians have used positive oscillating pressure and acoustic vibrations to mobilize thick, viscous mucus in the lungs of patients with cystic fibrosis or bronchiectasis. Recently, a pulmonologist in Columbia, SC invented a device called Sinusonic which applies these same principles to the nasal cavity and sinuses. We conducted the first study of this device in 40 patients who had chronic nasal congestion and had failed standard treatment with nasal steroid sprays and antihistamines. Approximately 80 percent of patients had clinical improvement in symptoms of nasal blockage and congestion using validated outcome instruments. These symptomatic improvements were confirmed by examining peak nasal inspiratory flow which also showed clinical improvement. Benefits were noted in both allergic and non-allergic rhinitis patients. The complete study results were published in the **International Forum of Allergy and Rhinology** ([onlinelibrary.wiley.com/doi/10.1002/alr.22740](https://onlinelibrary.wiley.com/doi/10.1002/alr.22740)).

Our group is examining other possible uses for this novel device, such as Eustachian tube dysfunction. Additionally, otolaryngologists often encounter patients with sinus pain/pressure but clear endoscopy and sinus CTs. In these cases, determining the cause of symptoms can be quite challenging and patients become frustrated with the standard sinus and pain medications typically prescribed. An ongoing study is examining the potential use of SinuSonic as a non-pharmacologic therapy to alleviate symptoms in this challenging group.

Finally, it is known that acoustic vibrations, such as humming, trigger dramatic increases in release of nitric oxide (NO) in the form of a gaseous molecule from the sinuses. It is unknown if this is the mechanism by which SinuSonic works, but NO has known anti-inflammatory, anti-viral and anti-bacterial properties, and can stimulate mucociliary clearance. External administration of high doses of NO is currently being studied for treatment of COVID. MUSC is executing a national study investigating the use of SinuSonic and its potential use in prevention of viral URIs. Stimulation of natural NO production in this manner may provide a creative, cost-effective method to treat respiratory viral conditions.



MUSC Otolaryngology has one of the largest clinical trials divisions in the country with expertise in conducting clinical trials for diverse conditions across the entire spectrum of ear, nose and throat conditions with novel devices, pharmacologic therapies and surgical treatments. We are especially proud of our Clinical Research Fellowship Program and the Clinical Trials Program that **Dr. Shaun Nguyen** directs. This program has mentored 70+ medical students matching into otolaryngology residency and 80+ students admitted to medical school. In addition, 100+ investigators in otolaryngology, general surgery, internal medicine, pulmonology, and urology have benefitted from this training. Dr. Nguyen has served as PI and Co-I on more than 300 clinical trials and has authored over 250 peer-reviewed publications, with special expertise in outcomes research involving systematic review and meta-analysis. □

## About Hypertonic Saline and Covid-19

Shaun A. Nguyen, M.D., FAPCR

Recently, nasal irrigation was found to reduce symptom duration of common upper respiratory viruses, including the coronavirus. Post-hoc secondary analysis of the Edinburgh and Lothians Viral Intervention Study (ELVIS) pilot randomized controlled trial found patients infected with coronavirus and treated with hypertonic saline irrigation to experience a shorter symptom duration of 2.5 days compared to controls.<sup>1</sup> The study strongly suggests that hypertonic saline nasal irrigation and gargling should be considered as a safe, successful option to help treat coronavirus and its symptoms.

The ELVIS study included 66 adults infected with upper respiratory tract infections (URTI) within 48 hours of study onset. They conducted daily hypertonic nasal irrigation sessions at home when needed (a maximum of 12 times daily).

Although nasal irrigation as a treatment for COVID-19 has not been studied thoroughly, these are promising results. NeilMed® has always advocated nasal irrigation to promote good health and is pleased that these preliminary results support this approach and provide a potential adjunctive therapy for COVID-19.

NeilMed® will continue to contribute to research involving saline nasal irrigation and especially its use in COVID-19 patients. To facilitate this research, NeilMed® has developed and launched a Hypertonic Sinus Rinse Kit.

### About NeilMed® Pharmaceuticals, Inc.

NeilMed® is a privately held, family owned OTC Healthcare company founded in 2000 by Nina Mehta and Ketan Mehta, MD. NeilMed® is the largest manufacturer and supplier of LVLP (Large Volume Low Pressure) saline nasal irrigation systems in the world. The flagship product has been Sinus Rinse for LVLP. Their line of products helps alleviate common nasal and sinus symptoms in a simple, safe, effective and affordable way. Saline irrigation has made a pivotal difference in nasal and sinus care for symptomatic patients during the perioperative period. Over the last decade, NeilMed® has successfully launched several innovative products in first aid, baby care and ear care. NeilMed® has expanded in close to thirty countries worldwide.

NeilMed® prides itself in being a part of the small community of Santa Rosa, located in the heart of Sonoma County's wine country of Northern California. At the onset of the Covid-19 pandemic, NeilMed® contributed \$100,000 in PPE for local hospitals, healthcare providers and emergency services, as well as quickly modified equipment to begin manufacturing hand sanitizer for use in its own facilities as well as donation to local businesses or essential workers in need.

There are joint research initiatives between the MUSC Department of Otolaryngology – Head and Neck Surgery and NeilMed® Pharmaceuticals, Inc.

1. Ramalingam S, Graham C, Dove J, Morrice L, Sheikh A. Hypertonic saline nasal irrigation and gargling should be considered as a treatment option for COVID-19. *J Glob Health*. 2020;10(1):010332.



**NeilMed®**

# 2021 Continuing Medical Education Events



## The Charleston Pharyngoesophageal Manometry Program

Virtual Live Stream Interactive Event

January 15-16, 2021

This two half-day introductory/intermediate program, designed for speech language-pathologists, laryngologists, and otolaryngologists, will consist of didactic sessions to introduce participants to the basics of pharyngoesophageal high-resolution manometry (HRM). Case based examples will serve to expand participants' understanding of the clinical applications of HRM. Both pharyngeal and esophageal examinations will be covered. We will focus on the diagnostic and therapeutic capabilities of HRM as well as protocols for pharyngeal dysphagia patients. CEU credits will be available.

## The ABCs of Maxillofacial Prosthodontics Medical and Dental Billing

Virtual Live Stream Interactive Event

January 29, 2021

This one day course is designed for dentists, prosthodontists, oral/maxillofacial radiologists and maxillofacial prosthodontists to review medical and dental billing for medically necessary dental treatment including: general dentistry, prosthodontics, radiology (including cone beam technology) and maxillofacial prosthodontics.

## Southern States Rhinology Course

April 22 - 24, 2021 Kiawah Island and MUSC Campus

This course is intended for practicing Otolaryngologists and will feature presentations on topics for the practicing rhinologists and sinus surgeons. A hands-on laboratory dissection is available, featuring state-of-the-art endoscopic instrumentation, video, and image guidance systems.

## The Charleston Course, 11th Annual Otolaryngology Literature Update

July 16 & 17, 2021 Kiawah Island Golf Resort

This course is designed to help the busy clinician stay current in our rapidly expanding specialty. Fifteen of our faculty members are charged with reviewing last year's literature and choosing five to eight best articles in their subspecialty for critical review. In two days, more than 100 manuscripts will be reviewed, and those "pearls" important to your practice will be emphasized. There may be no better way to stay current in our field than with the Charleston Literature Course!

## The Charleston Vestibular Update

November 5-6, 2021 MUSC Campus

This one-and-a-half day conference is designed for all providers involved in the care of patients with vestibular disorders. The course will cover many key topics on the evaluation and management of dizzy patients to provide current knowledge and the ability to employ best practices when servicing this population.

## The 36th Annual F. Johnson Putney Lectureship in Head & Neck Cancer

Fall 2021 MUSC Hollings Cancer Center

This half day lectureship will bring together world class Head and Neck specialists to discuss improving the quality of health care for patients with head and neck cancer.



## Ranked #13 in the Nation

The MUSC Department of Otolaryngology - Head & Neck Surgery continues to rank among the elite programs in the country in education, clinical research and clinical trials, basic research, and patient care. "We take enormous pride in this special Department, but acknowledge that our Department does not function in isolation, and thus we applaud the leadership and infrastructure provided by MUSC and our amazing colleagues across the enterprise."

Paul R. Lambert, M.D.  
Professor and Chair  
Department of Otolaryngology - Head & Neck Surgery



Some details are still in the works! Visit our website for updates: [musc.edu/ent/cme](https://musc.edu/ent/cme)  
For course registration or more information: Julie Taylor, [taylojul@musc.edu](mailto:taylojul@musc.edu) or 843-876-0943

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## THE MEDICAL UNIVERSITY OF SOUTH CAROLINA

Founded in 1824 in Charleston, the Medical University of South Carolina is the oldest medical school in the South. Today, MUSC continues the tradition of excellence in education, research, and patient care. MUSC educates and trains more than 3,000 students and nearly 800 residents in six colleges, and has more than 17,000 employees. As the state's only integrated academic health science center and largest non-federal employer in Charleston, the university and its affiliates have collective annual budgets in excess of \$3.2 billion, with an annual economic impact of nearly \$4 billion and annual research funding in excess of \$284 million.

As the clinical health system of the Medical University of South Carolina, MUSC Health is dedicated to delivering the highest quality patient care available, while training generations of competent, compassionate health care providers to serve the people of South Carolina and beyond. Comprising some 1,600 beds, more than 100 outreach sites, the MUSC College of Medicine, the physicians' practice plan, and nearly 275 telehealth locations, MUSC Health owns and operates eight hospitals situated in Charleston, Chester, Florence, Lancaster and Marion counties. In 2020, for the sixth consecutive year, U.S. News & World Report named MUSC Health the No. 1 hospital in South Carolina.

Changing What's Possible